



Operation Manual

for Reference Recorder & Lab Reference



CRYSTAL
engineering corporation

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Introduction

Thank you for choosing the nVision Reference Pressure Recorder from Crystal Engineering Corporation. Your nVision is a combination of leading edge technology and rugged industrial design.

Accuracy is up to 0.025 percent of reading - so any nVision can typically replace several gauges or calibrators you may have been using. The nVision is fully temperature compensated - so there is no change in accuracy throughout the entire operating temperature range!

The nVision features two identical bays allowing configuration of the reference recorder to meet your requirements. All modules are field-replaceable allowing you the flexibility to react to changing needs and module calibration requirements.

The nVision's case is made from a rugged injection molded polymer utilizing a gasket to seal the enclosure against dust and water intrusion. Even the mini USB B connector is fully sealed (with or without the protective boot cover). Circuitry is mounted in a shock-absorbing elastomeric system and the batteries are easily accessible by removing four captive screws.

Other features include:

- Log and display 500,000 points at up to 10 readings per second on up to two modules simultaneously
- Interactive real-time graphing of measurements
- ATEX / IECEx Scheme intrinsically safe (nVision Reference Recorder only)
- IP67 rated enclosure —1 meter immersion for 30 minutes (nVision Reference Recorder only)
- Uses Crystal's new CPF fittings and hose system (leak-free and finger-tight to 10 000 PSI (700 bar))

We hope your nVision meets your expectations, and we're interested in any comments or suggestions you may have. You can send us a note at: sales@crystalengineering.net. Many features in this and our other products are a direct result of your comments!

Crystal Engineering is the company that designs, manufactures, markets and services the nVision reference recorder, XP2i series pressure gauges, 30 series pressure calibrators, MultiCal multimeter pressure adapters and a variety of industry specific pressure measuring equipment. Crystal Engineering pioneered features like full temperature compensation and "of reading" rated gauges and calibrators. Pressure measuring equipment is the only thing we do and that's why we say:

PRESSURE is Our BUSINESS™

Your nVision can also be customized to meet your specific test needs through the use of CrystalControl™ software. Your personal computer can disable, enable or modify a variety of features of your nVision. Look for the **CRYSTAL CONTROL** logo for user programmable features, like:

- User defined pressure units, and/or disable unused pressure units
- Password protection to prevent unauthorized changes to gauge settings and/or product keypad access
- Expand or decrease allowable Zero range
- Set the gauge to a different density of water factor (4°C, 60°F or 68°F)
- Store custom ID or tag numbers in non-volatile memory
- Adjust calibration values

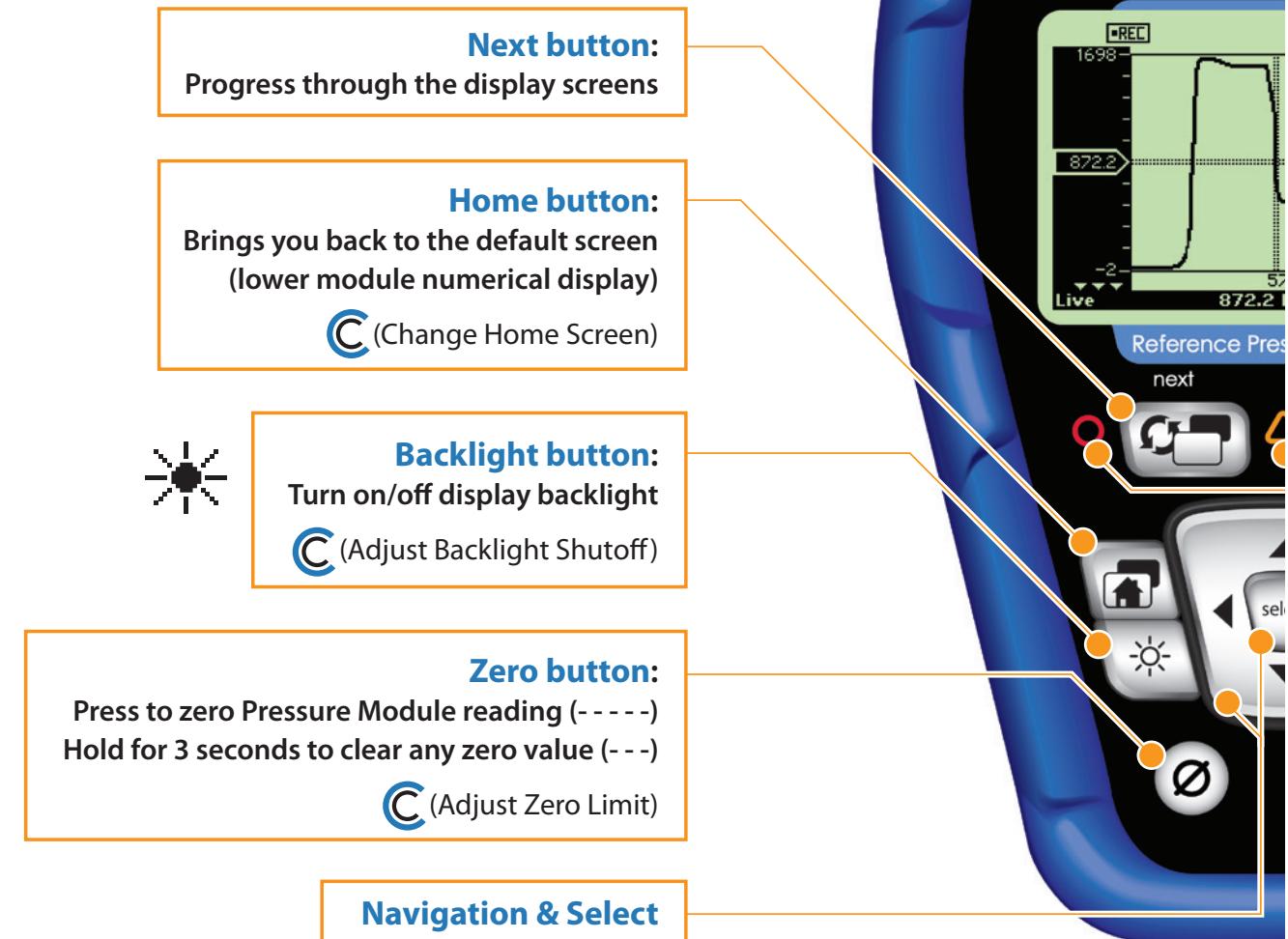
Quick Start Instructions

Power Icon Key - nVision Reference Recorder						
Icon						
Description	External Power (USB)	100%	75%	50%	25%	0%**
Power Remaining						

**Replace Batteries or connect to USB Power



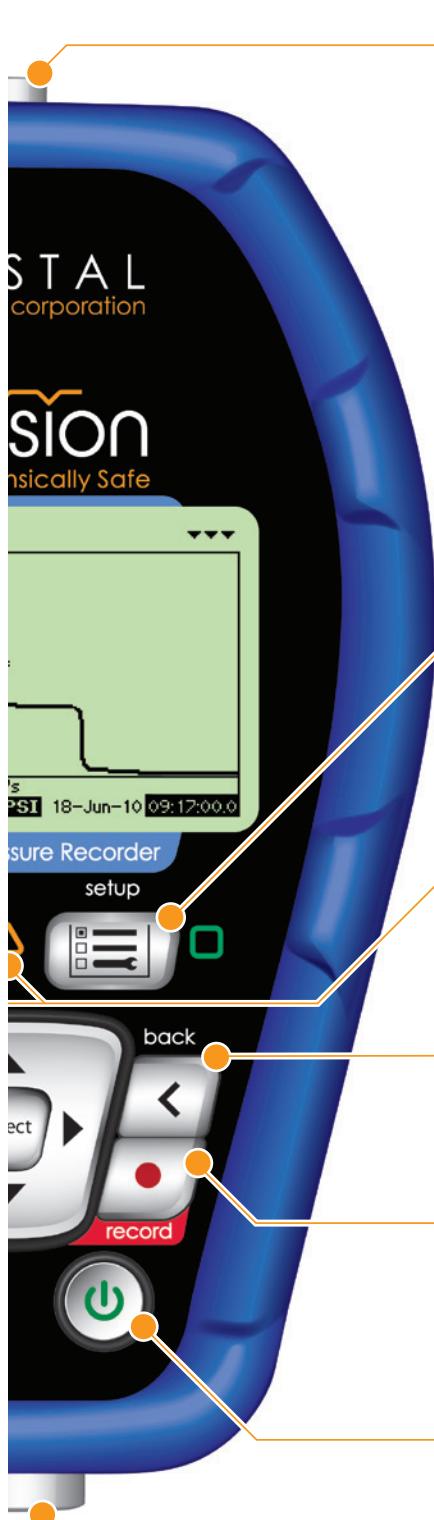
Power Icon Key - nVision Lab Reference		
Icon		
Description	External Power (AC Adapter)	USB Connection*
*USB Connection is for data transfer only		



nVision Reference Recorder shown.

All instructions on this spread are also applicable to
nVision Lab Reference

 This icon represents a component that can be modified with **CrystalControl** software



Upper Module Bay

Setup Button:

Locate additional features:

- Clear Peaks
- Units  (Adjust Available units)
- ▼ Settings
 - Contrast
 - Lock/Unlock Chassis 
- ▼ Summary
 - Chassis, Upper, Lower
- ▼ Recording
 - Start/Stop
 - Erase All Runs



LED Indication alerts:

○: Flashes while recording

(Flashes quickly when recording ends)

△: Flashes when an overpressure condition occurs

Back button:

Previous Display Screen



Record button:

Start/Stop data recording

 (Adjust Logging Interval)

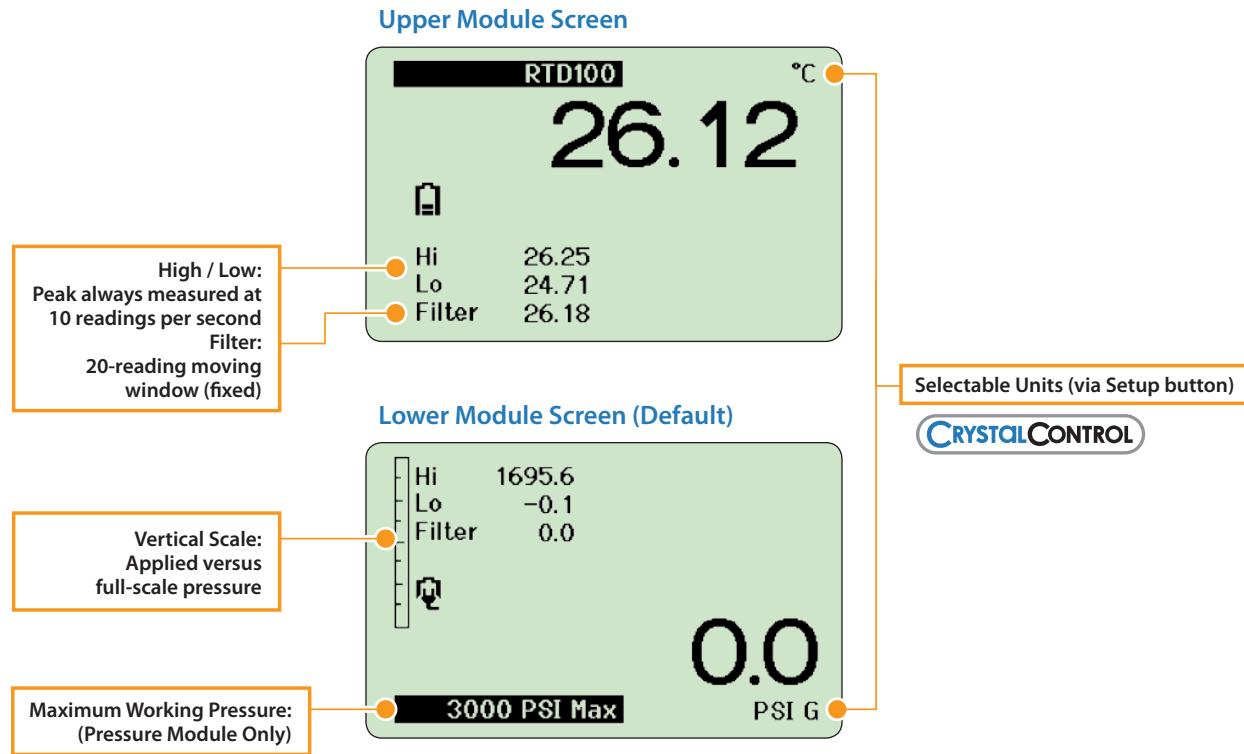
Power button:

Turn your nVision on/off

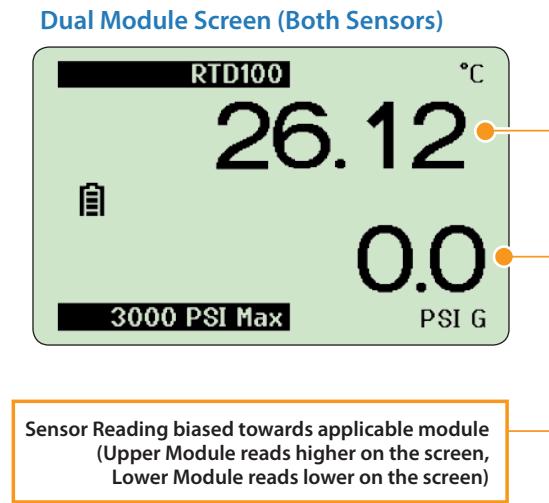
Lower Module Bay

Numerical Display Overview

Numerical Upper and Lower Module screens

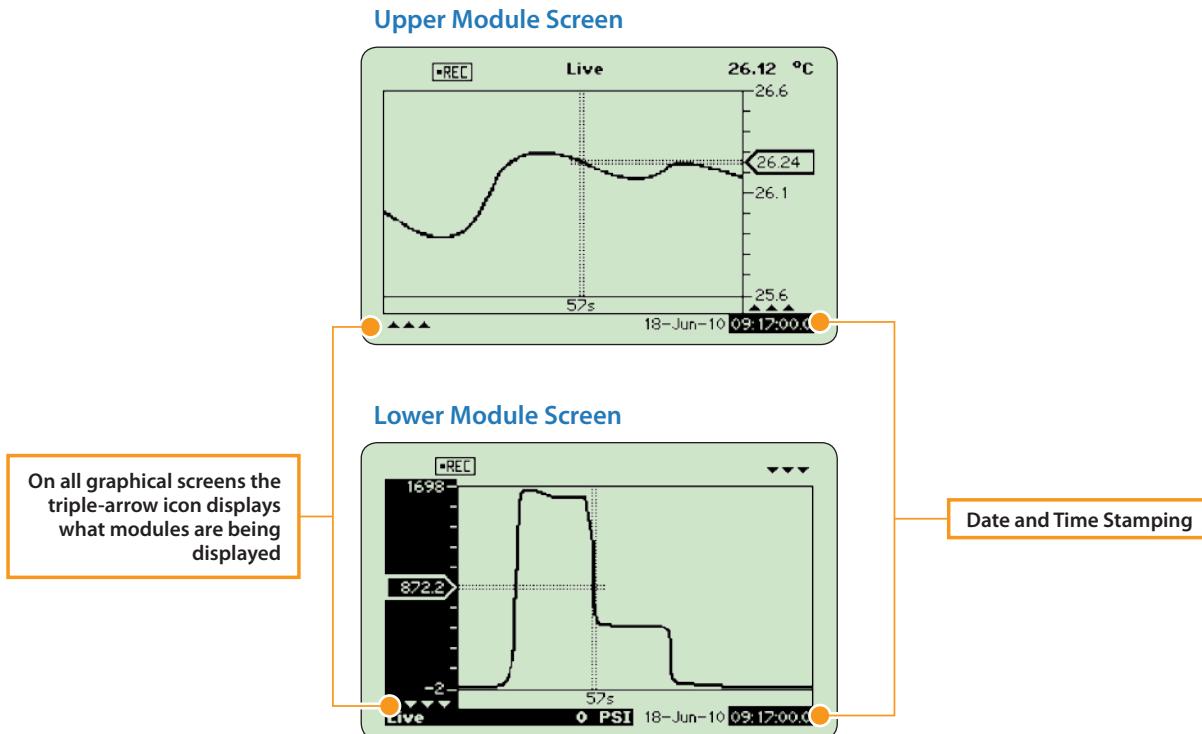


Numerical Dual Mode Screen (Both Sensors)

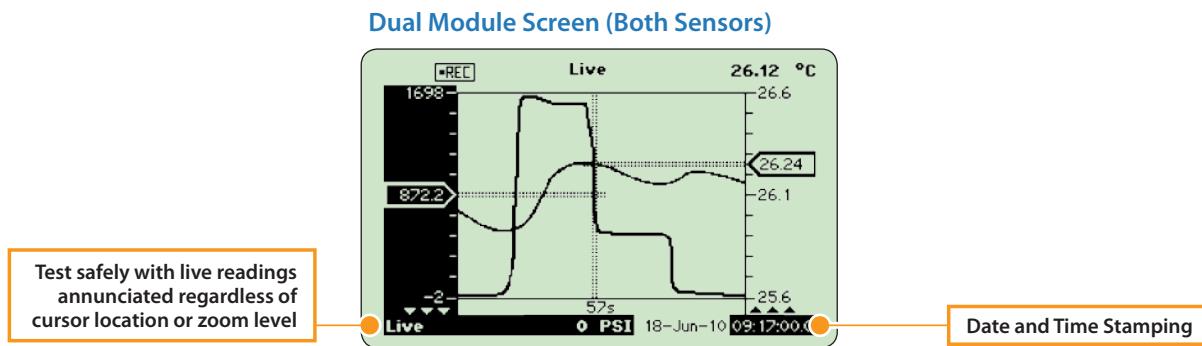


Graphical Display Overview

Graphical Upper and Lower Module screens

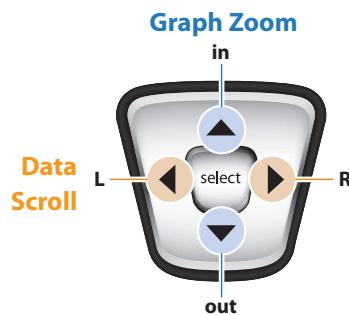


Graphical Dual Mode Screen (Both Sensors)



Navigating the Graphical Display

In the graphical modes the nVision navipad enables you to control how you view your data.



Data Scroll Using the & keys allows you to navigate to specific points along your run, while displaying reading and time information.

Graph Zoom Using the & keys allows you to zoom in and out of your recorded run to suit your needs.

Operating Instructions

The nVision reference recorder is designed to be robust and easy to use. The following is further detail on the functionality of the product that may already be summarized in the Quick Start Instructions above. The main button features, clock-wise are:



Home button

The nVision reference recorder has multiple viewing screens available for your use. If you ever need to get “**home**” simply press the home button to get you to a familiar or default view.



CRYSTALCONTROL You may customize your nVision to select different Home screens through CrystalControl.



Next button

On the nVision, pressing the **next** button allows you to scroll through the available nVision screens.



Setup button

Pressing the **setup** button brings up a selectable menu of features such as **Clear Peaks, Units, Settings, Summary** and **Recording**. Use the navigation button up/down arrows to move to the desired feature and use the **select** or **right arrow** buttons to move into the desired function.

► **Clear Peaks (Resetting Hi and Lo Peaks)**

Peak values (Hi and Lo) can be cleared via the **setup** menu. Press the setup button; navigate to **Clear Peaks** with the **up/down** arrows and use the **select** button to pick the desired function. Dashed lines will then briefly appear across the display indicating that both peak values (Hi and Lo) have been cleared. Clearing the peaks will not affect the zero value of the main display and will not clear the Filter value. If you need to rezero the gauge, simply press the zero button.

► **Units**

Selecting **Units** allows you to choose the next available unit of measurement. Use the **right/left arrow** keys to change the units on the display and press **select** to accept the change. See the module specifications for the list of available units for your module.



CRYSTALCONTROL Units not enabled in CrystalControl will not be available for use on the nVision. Also note that **User Defined Units** created in CrystalControl will also be accessible in this listing if enabled.

► **Settings**

Display contrast can be adjusted in the **Settings** menu item. This allows you to optimize your nVision viewing experience to your ambient lighting conditions and backlight needs. When **Contrast Adjust** is highlighted, use your right/left arrows to adjust and press **select** to capture the new setting.

CRYSTALCONTROL The **Screen Lock Password** feature will also be found in **Settings**, if enabled in CrystalControl. Prevent access to your nVision by protecting your device with a 4-digit keypad lockout set in CrystalControl. Highlight **Lock Chassis** and press the **select** button to lock your nVision (the  icon will appear). To unlock the nVision, simply enter the 4 digit password with the arrow keys and **select**. The correct password will allow you back into standard nVision operation. An invalid code will reject your attempt and allow you to enter another password.

In the event you lose the password, you will need to contact the factory for an unlock code, which will remove the password protection.

► **Summary**

Not sure of what modules or settings you have loaded in the nVision? The **Summary** item allows you to view valuable details or settings in your chassis or module. To view a specific module summary you will need to choose **Chassis**, **Upper Module** or **Lower Module**. Items in this section cannot be edited with the nVision chassis but may be modified in CrystalControl. The specific information in the Summary screens are:

Chassis Summary: Serial Number, Firmware Version, CPLD Version, Date/Time, Automatic Shut-off, Backlight Shutoff, Logging Interval, Message Store, and module model and serial numbers.

Module : Model, Serial Number, Firmware Version, Calibration Date, Calibration Due, Message Store, Userspan, Available Units, and module specific information such as Temp. Coefficients (RTD100), Base Resistance (RTD100), Lead Type (RTD100), and Zero Limit (PM)

CRYSTALCONTROL With the exception of Model, Serial Number, and Firmware Version, all features can be modified in CrystalControl to optimize your nVision.

► Recording

You may **Start** or **Stop** a run from the **Recording** menu item.

CAUTION: Never remove power (either battery or USB power) or update your nVision using CrystalControl when Recording as this may corrupt your recorded data.

Additionally you may **Erase All Runs** in order to effectively manage the 500,000 data point memory capacity of the nVision. When this command is selected, the nVision will erase the full on-board memory in less than 2 minutes.

CAUTION: Never remove power (either battery or USB power) during the erasing process.

CRYSTALCONTROL In order to permanently archive your data, it is recommended to save any data files via the **Export Data** file feature in CrystalControl.



Navigation & Select buttons

Whenever you need to navigate, the nVision utilizes **up/down** and **left/right** arrow navigation buttons. Any time you need to select an object, press the center **select** button.



Back button

Pressing the **back** button allows you to go backward through the available screens (opposite of next button).



Record button ()

Recording a data run is simple with the nVision. To **start** (LEDs solid) or **stop** (LEDs flash) a recording run from any screen simply press the record button for one second. Recording logs all the data from all the enabled screens, so even if you are viewing the lower module numerical display, the upper data will be recorded and available for CrystalControl downloading, viewing and archiving. The recording or Logging interval of your nVision can be viewed in the Chassis Summary Screen, located in the Setup menu.

CRYSTALCONTROL The product has the capability to record at rates from 10 readings per second to 1 reading per hour as set in CrystalControl. Adjust your recording rate to optimize battery life and data recording needs to your specific application. Note that the nVision will record all data related to the units or screens checked as "available" in CrystalControl and listed in the **Summary** screens. Units or screens that are not checked as "available", will not be available for downloading, viewing, or archiving in CrystalControl.

Your nVision memory has capability to record more than 500,000 data points if both module bays are populated. If you have one bay populated, this number doubles. CrystalControl will give you a more accurate view of recording times based on the logging rate and enabled screens for your nVision.

The Automatic Shutoff timer will not shut off your nVision while recording.

Recording Rate (Set in CrystalControl)	Elapsed recording time to fill memory (>500,000 data points with two modules)
10 readings per second	Approximately 14 hours capacity
1 reading per second	Approximately 140 hours capacity (or approximately 6 days)
1 reading per minute	Approximately 8300 hours capacity (or approximately 375 days*)

*Note: batteries will self drain in this time period.

These numbers assume lower, upper and dual numerical and graph screens enabled.

The nVision can store a maximum of 64 recording runs before data must be erased through the Erase All Runs command in the Setup menu.

CAUTION: Never remove power (either battery or USB power) when Recording.



Power button

Power up the nVision product by pressing the **power** button. The nVision will automatically power down if not used for 20 minutes to conserve battery life (or some other duration set in CrystalControl).

CRYSTALCONTROL Adjust your **Automatic Shutoff** time (shut off time in absence of key press) to optimize battery life to suit your needs. Feature is adjustable from 30 seconds to always on (until batteries are dead). The timer will not shut off your nVision while recording.

When powered by USB, the nVision does not employ any power management strategies. Therefore, it will not automatically shut off to the settings defined by CrystalControl.

CAUTION: Never remove power when Recording.



Zero (PM)

To zero the nVision you must press the button for at least 1 second. The display will then briefly flash all dashed lines (----), indicating that it has been re-zeroed. If you attempt to zero the gauge while more than 20 PSI is applied (or the **Zero Limit** set with CrystalControl), the command will be ignored, and “- -HI- -” will be displayed.

CRYSTALCONTROL You can adjust the **Zero Limit** at which the Zero button will display “- -HI- -” in CrystalControl. For instance, you could set the maximum zero to 3000 PSI, if you need to mix high pressure gases. You can also disable the zero button entirely, by setting the Zero value to a large positive or negative number.

WARNING: This gauge can display zero pressure when connected to a source of pressure! Do not rely on the display indication before disconnecting – it may not be indicating true pressure. Never disconnect pressure instrumentation without first relieving system pressure!

To clear the zero value on an nVision, hold the button for 3 seconds until the display changes from (----) to (- - -).



Backlight button ()

Pressing the **backlight** button instantly illuminates the display for a duration set by CrystalControl. The default duration is 15 seconds and can be custom set all the way up to never timing out. Battery life is affected by backlight use.

CRYSTALCONTROL Adjust **Backlight Shutoff** to optimize your illumination needs against battery performance.

Display Screens: Numerical and Graphical

The nVision has several different screen views to aid in viewing live and recorded data. You may view in either numerical or graphical modes, and you may view either of the available module bays individually or in dual mode. You may use the recording capabilities of the nVision from any screen view you may choose.

The three main data viewing modes are:

- 1 Live:** These are live, real-time readings that are not being recorded into memory (no Record icon illuminated).
- 2 Live Recording:** Real-time readings that are being recorded () into the 500,000 data point memory capacity.
- 3 Last Recorded:** This is previously recorded data available for viewing.

CRYSTALCONTROL CrystalControl will allow you to enable or disable screens, rearrange the order they will appear, select your Home screen, or restore defaults.

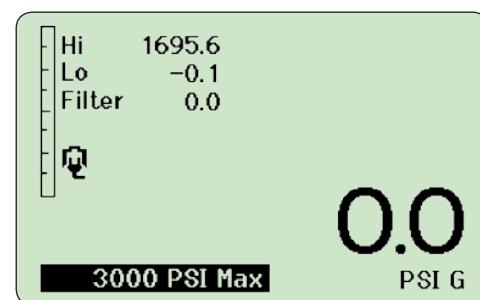
CRYSTALCONTROL Note that you may view all the previously recorded data in CrystalControl, but only the last recorded run on the nVision chassis.

Numerical Display Screens (Live and Live Recording Data)

The nVision numerical screens allow you to view **live** or **live recording** data in a traditional way. Peak Hi and Lo, and Filter values are annunciated, in addition to module specific features such as maximum allowable working pressure (MAWP) of the module (PM), vertical pressure scale (PM) and of course, the unit of measure.

The available Numerical screens are:

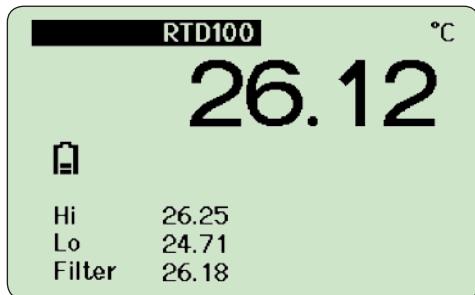
- Lower
- Upper
- Dual: Upper and Lower
- Differential (if two similar modules are installed)
- Average Lower
- Average Upper



Lower Module Numerical Screen

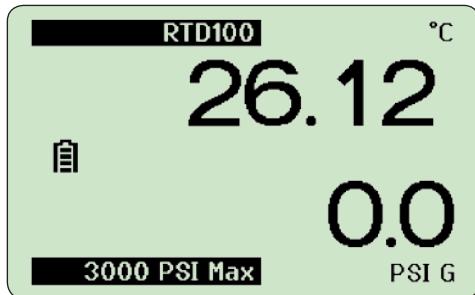
The **Lower Module Numerical** screen has the information biased towards the lower module to help you identify the location of the module in question. The example shown is that of a 3KPSI module (PM) located in the lower bay (powered by USB power).

The upper module screen will also have its relevant data biased toward the top for identification purposes. The following is a representative screen from a temperature (RTD100) module located in the upper bay.



Upper Module Numerical Screen

If you desire to view both the upper and lower numerical displays simultaneously, the dual view is also possible (shown with battery capacity at 100%).



Dual Module Numerical Screen

Peak Detection and Filter

On the nVision, you may view the peak high (Hi), peak low (Lo), and filter (Filter) readings on the numerical displays. Peak high, peak low and filter values are not saved when the gauge shuts off; they will reset to the current reading when the **nVision** is turned on or reset.

► Peaks

Hi and Lo readings are useful for seeing rapidly changing events such as pressure during a relief valve test, or longer duration events such as measuring pressure and temperature during pipeline hydrostatic testing.

Hi Maximum recorded reading

Lo Minimum recorded reading

► Filter

Filter is the average reading of the main display (and not the average of the Hi and Lo). It updates in a fixed, twenty (20) sample moving window and offers a damped view of your data.

Numerical Display Screen (Differential Mode)

The nVision will automatically display an additional differential screen if two similar module types are installed at the same time. An example of this would be two pressure modules (PM) or two RTD100 modules installed simultaneously. In the case of the pressure modules (PM), this mode does not require them to be the same full scale range.

WARNING: Two MA20 modules are not allowed to be installed at once as this configuration may permanently damage your nVision.

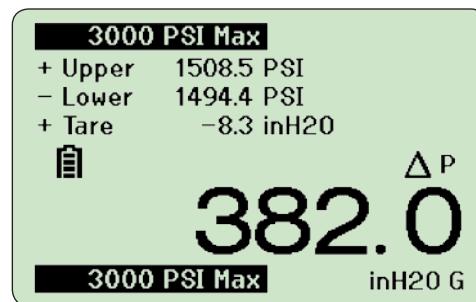
The differential screen is shown in the following example. The ΔP or ΔT represents a filtered reading of the upper module – lower module + tare reading.

► Upper, Lower and Tare

Your nVision will annunciate the live readings for both the upper and lower sensors for your easy viewing. Both the Upper and Lower readings in this mode are filtered and offer a dampened view of your data. Additionally it contains a Tare function that allows you to equalize the upper and lower sensor readings. To clear the Tare value in Differential Mode, hold the  button for 3 seconds until the main display readings change from (----) to (---).

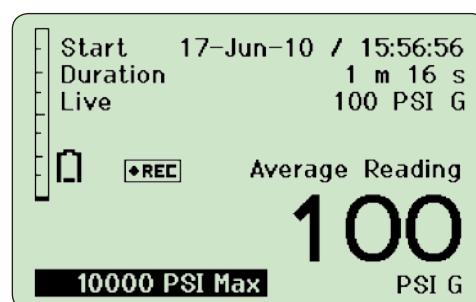
- + Upper ... Filtered live reading of upper module
- Lower.... Filtered live reading of lower module
- + Tare Allows ability to equalize lower module to upper by pressing the  button until the display briefly flashes all dashed lines (----). See the Differential Mode section for further details on improving your measurement uncertainty while using this function.

You may independently change the units of the Upper/Lower or Tare/ ΔP or ΔT readings through the Setup button. The units selected for this view are independent of the units selected for the other screens such as the Dual or Graphical views. Data viewed in the Graphical screens will represent the data acquired from either module and not represent the specialized view of the Differential Mode.



Numerical Display Screen (Averaging Mode)

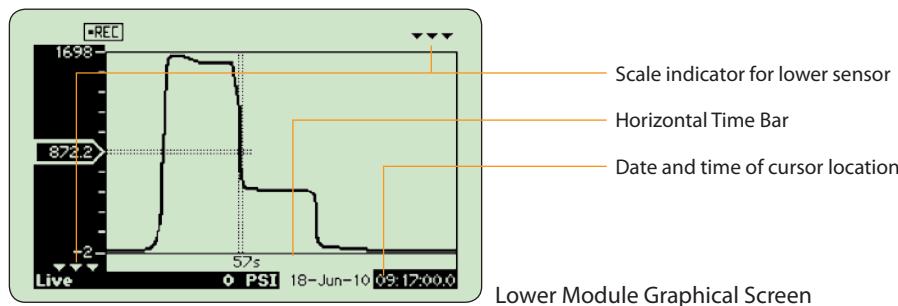
The nVision has an averaging mode that reports the average reading during the recorded run. Simply press the record button and it will average the data until you press the record button again. Data such as the start date and time, duration of the recorded run, and the live reading are displayed. You may also view the data in DataViewer and export the data if so desired.



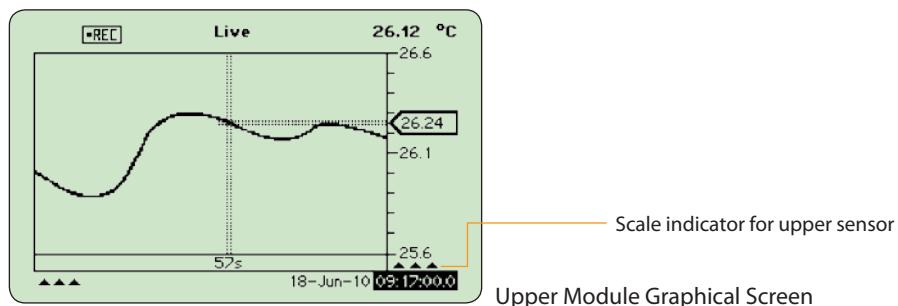
Graphical Screens (Live Recording, or Last Recorded Data)

The nVision graphical screens allow you to view **live recording** or **last recorded** data utilizing the advanced viewing capabilities of the nVision display.

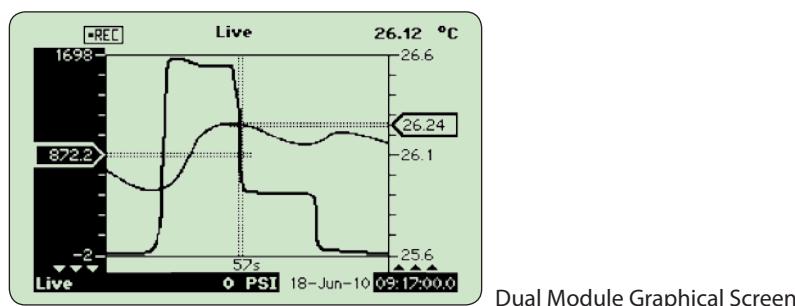
Like the numerical screens, the border of the graphical screens wraps around the display with a bias towards the module under test. The following is an example of a 3KPSI module (PM) located in the lower bay, with the cursor moved to the center of a 57 second Live Recording run (REC icon is present).



The upper module data will also have its border wrapping around the top for identification purposes. The following is a representative screen from a temperature (RTD100) module located in the upper bay.



If you desire to view both the upper and lower graphical displays simultaneously, the dual view is also possible.



When viewing data with a dual PM or dual RTD100 module installation, the graphed data will represent the actual, pre-tare readings and not the ΔP or ΔT reading. As a result, the Tare value will not be indicated in this view.

If desired, you may also view the Differential or Averaging screens (for lower or upper modules).

Viewing Graphical Screen Data in Detail (Live Recording, or Last Recorded Data)

► Complete Data Run Viewing

When viewing the nVision graphical display screens the **live recording** data streams into the viewing window from the right hand side of the display. Therefore, live recording data will always appear on the far right hand edge of the display when you are viewing the complete recording session.

The nVision also comes with a cursor for your use within the display window. When the cursor is located in the default far right side of the screen, the cursor arrows will report live readings for the populated modules. The lower horizontal time bar reports the increasing duration of the live recorded data. This helps you keep track of the size of your data while recording. This helps you identify the size of your recorded data window shown on the nVision.

► Viewing Specific Data Points or Times

Moving the cursor from the far right hand side of the display allows you to view specific data points or time stamps within the displayed run. As you move the cursor with the right/left arrow keys (◀/▶) you will notice the time stamp changing in the lower right hand box. This is the time stamp of the specific data point corresponding to the cursor location and reading. If you are searching for a specific measurement within your recorded test, use the cursor readings or time stamp to locate the required information. Return the cursor to the far right location by using the right arrow key.

To ensure safety, **Live** readings are always annunciated on the display regardless of cursor location or zoom level.

► Zooming in on Specific Data

You may also zoom in or out on your cursor data view by using the up/down arrow keys (▲ / ▼). When zoomed to any level other than the full data view, small arrows will appear at each end of the horizontal time bar. This time bar describes the size of the window displayed on the nVision. During any zooming keystroke a zoom in (🔍) or zoom out (🔍) icon will annunciate in the upper left hand of the display.

To return to the full zoom out view (viewing complete run) simply hold the down arrow for 5 seconds or until you are completely zoomed out.

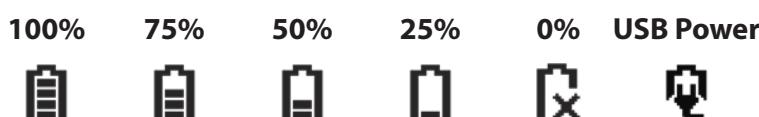
Power (Battery and USB)



nVision Reference Recorder only

Low Battery Indication

The battery icon has the following states:



The  icon will appear when the batteries are exhausted and will need to be changed to ensure full functionality of the nVision. Continued use will further drain the batteries to a non-operational state where the message "Replace Batteries" will appear across the display. From this state, the only operational parameter will be the power button. After "Replace Batteries" appears, no measurements will be possible until the batteries are replaced, however, the recorded data will be preserved.

CAUTION: Never remove battery or USB power when Recording.

WARNING: Do not remove or change the batteries in a hazardous atmosphere.

Extending Battery Life

Note that the nVision reference recorder has many customizable battery saving features available to you for optimization in CrystalControl.

 You may extend battery life substantially by slowing down your Logging Interval (recording rate) and reducing the Automatic Shutoff and Backlight Shutoff times.

The nVision will continue recording even if you have the Automatic Shutoff timer enabled. When the timer elapses a power savings screen will appear as shown. To return to normal operation simply press any key.



Battery Replacement

The nVision uses four AA batteries. Unscrew the four captive screws (knurled Phillips head) to gain access to the battery compartment. Replace the batteries taking care to note polarity for their proper installation. After replacing the batteries and reinstalling the power module, the nVision will start operating immediately (without having to press the  button). This indicates that a complete reset has occurred, and is normal. Verify the battery module is properly sealed and installed to maintain your IP67 rating. Failure to properly seal the battery compartment may allow water damage that could permanently compromise the nVision. IP67 rating will be void if nVision is operated without 4AA power module in place.

WARNING: Do not remove or change the batteries in a hazardous atmosphere.

WARNING: The nVision is Intrinsically Safe only if powered by one of the following battery types: Rayovac Maximum Plus 815, Energizer® E91, Energizer® EN91, or Duracell MN1500. The ratings and ambient temperature ranges vary so take care to determine if you are selecting the proper replacement for your requirement.

Approved Battery Type	Ta=	Marking
Rayovac Max Plus 815	-20C to +50C	Ex ia IIB T4 Ga
Duracell MN1500	-20C to +45C	
Energizer E91, EN91	-20C to +50C	Ex ia IIB T3 Ga
Duracell MN1500		

REPLACE BATTERIES WITH APPROVED TYPE IN NON-HAZARDOUS LOCATIONS ONLY

USB power indication ()

The USB connected/powered icon will become active when connected. The mini USB B connection will power the nVision with and without the battery pack installed. Since the power module consists of alkaline AA batteries, they will not be recharged by the USB device.

IP67 rating will be void if nVision is operated without 4AA power module in place. Therefore, if you desire to power the nVision with USB it is recommended to install the 4AA power module (with or without batteries) to protect the reference recorder from the elements.

nVision under USB power consumes less than 100mA.

WARNING: The mini USB B connector shall not be used within the hazardous atmosphere. It shall be used in the non-hazardous atmosphere with either "Safety Extra Low Voltage Circuits" (SELV) or "Protective Extra Low Voltage Circuits" (PELV). See the nVision Product Specifications for a complete description of SELV and PELV. The USB connector has an Um of 6V.

Reset

If for some reason the nVision needs to be reset, remove the battery pack and USB power for at least one minute, then reinstall. If the reset is successful, the nVision will start operating without pressing the  button when the power pack is reinstalled.

WARNING: Do not remove or change the batteries in a hazardous atmosphere.

Automatic Shutoff

The nVision has an **Automatic Shutoff** timer and will turn off automatically after 20 minutes of non-operation (default value). Pressing any button or sending any command via the USB connection resets the shutoff timer for another 20 minutes of operation.

 The **Automatic Shutoff** feature can be defeated (always on), if desired, or customized to other values using CrystalControl. Battery life is enhanced by automatically shutting off the device at shorter intervals.

Note that under USB power, the shutoff feature is bypassed.

Pressure (PM) Module Instructions

Pressure Connection

Crystal CPF System: Medium Pressure Female (MPF) (1/4" medium pressure tube system with 7/16-20 threads). See Crystal Engineering's CPF Brochure for further information.

CPF o-ring size and material: AS568A-012, Viton 90 durometer (P/N 3981).

CAUTION: To achieve CPF maximum allowable working pressures no o-ring substitutions are allowed. See Crystal Engineering's CPF brochure and CES-003 CPF Safety Guide available from the website at <http://www.crystalengineering.net> for further detail.

Measuring Vacuum

All versions of the nVision can be used to measure moderate vacuum.

When measuring pressure less than ambient barometric conditions, a minus (-) sign will appear.

CAUTION: The nVision is not recommended for continuous use at high vacuum.

Water Density (Inches of Water)

The following applies only to models where inches of water is a selectable pressure unit. As shipped from the factory, the **nVision** is set to display inches of water corresponding to the density of water at 4°C (39.2°F).

CRYSTALCONTROL You may require a different water density for your application. CrystalControl allows the user to select the appropriate water density desired at 4°C (39.2°F), 20°C (68°F) or 15.6°C (60°F) temperatures.

Overpressure Conditions

The nVision will read pressure up to approximately 110% of the rated pressure range. Above 110% of the range the display will start flashing and the readings will not be reliable. The zero function does not affect the point at which the display starts flashing to indicate overpressure, so depending on the zero value it is possible that the display can start flashing without the maximum pressure being displayed.

For instance, if a 100 PSI nVision is zeroed when 30 PSI is being applied, it will indicate that the overpressure condition has been reached at 80 PSI (i.e., $110\% \times 100 \text{ PSI} - 30 \text{ PSI} = 80 \text{ PSI}$).

Overpressure can affect accuracy, but the effect is only temporary unless the sensor has been destroyed. See Pressure Module (PM) Specifications for maximum allowable overpressure ratings.

Current, Voltage, and Switch Test (MA20) Module Instructions

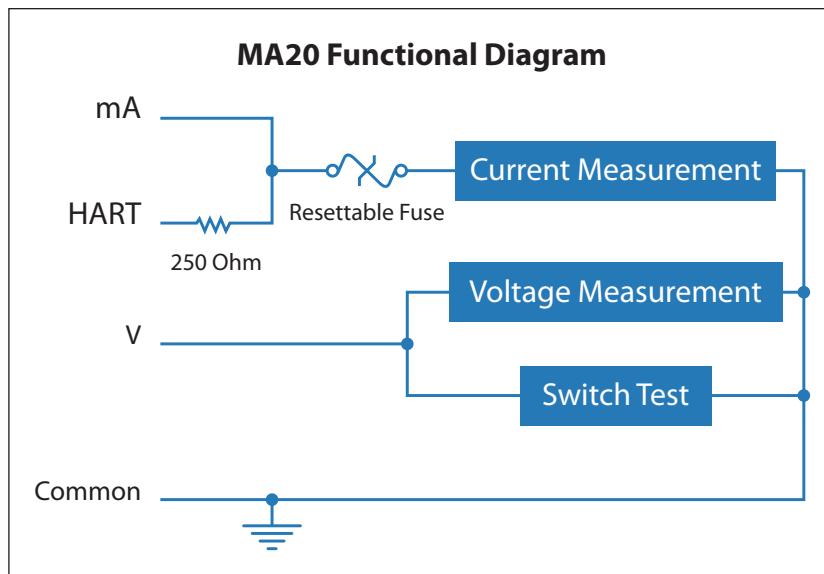
The nVision MA20 module has three operational modes: current measurement, voltage measurement, and switch test. Each mode may be selected via the Setup menu, and can only be operated one at a time.

To ensure proper connection to the MA20 Module use the following strategy:

- 1 Ensure that power is off on the circuit that you are about to measure.
- 2 Ensure your Vision is in correct MA20 Mode: mA, %4-20mA, Voltage, or Switch Test.
- 3 Insert the Negative (black) 2mm lead jack to the proper location (black terminal) on the MA20 module. Connect the other end of the black lead to the appropriate terminal of the source.
- 4 Insert the Positive (red) 2mm lead jack to the proper location (red terminal) on the MA20 module. Connect the other end of the red lead to the appropriate terminal of the source.
- 5 Power up circuit and measure or record the readings as appropriate.
- 6 Never change modes or electrical sources without first removing the nVision from the circuit. Failure to do so may damage the nVision.

WARNINGS: The following warnings apply to the MA20 module:

- Never install two (2) MA20 modules simultaneously. This configuration may permanently damage your nVision.
- Never exceed the maximum specified voltage or current ratings on the MA20 inputs. Doing so may permanently damage the MA20 module.
- Check the test leads for continuity before using. Replace damaged test leads. Do not use the probes if they are cracked, have damaged insulation, exposed metal, or high resistance.
- Always remove the test leads from the module before opening the battery compartment.
- When using test lead probes, always make sure your fingers are behind the finger guards on the probes.
- Never connect more than two (2) test leads to a MA20 module at a time.



Current Mode

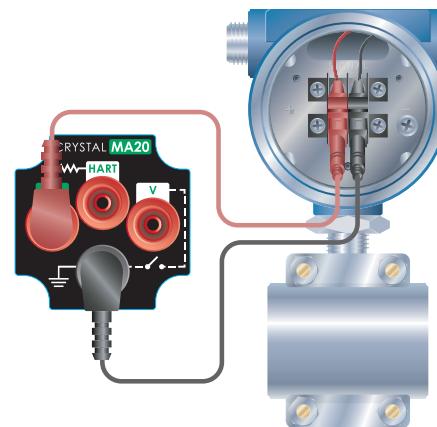
The nVision is capable of measuring current in two different modes. They are:

- **mA:** Measured current is displayed (mA).
The module is capable of measuring inputs up to 25mA
- **4–20%:** Current is displayed as a percentage of the 4–20mA current range of the module.
Where: 4mA = 0%, and 20mA = 100%

Both current modes are available for use if current is measured in the standard or HART connection schemes.

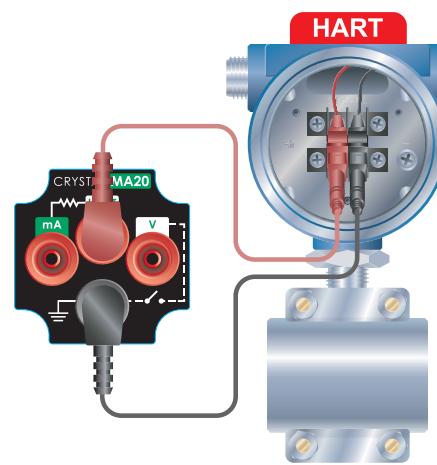
► Current Measurement

The nVision may be used to measure current up to 25mA. Select the desired current mode through the Setup menu to properly configure the nVision prior to connection and use. The illustration denotes the proper current measurement connection scheme to the MA20 module.



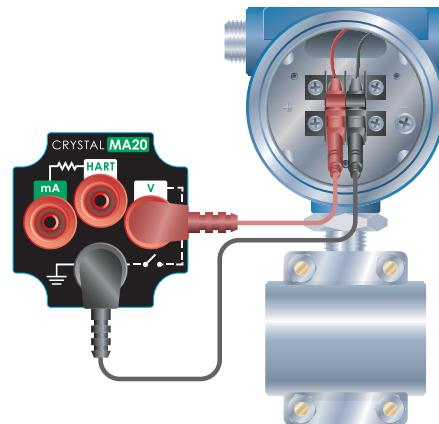
► Current Measurement with HART Resistor

The nVision may be used to measure current in a circuit that includes a HART transmitter or device. For devices that use the HART protocol, a load resistor must be placed in the loop. The HART input on the MA20 provides a 250 Ohm load resistor. Select the desired current mode through the Setup menu to properly configure the nVision prior to connection and use. The illustration denotes the proper HART resistor connection scheme to the MA20 module.



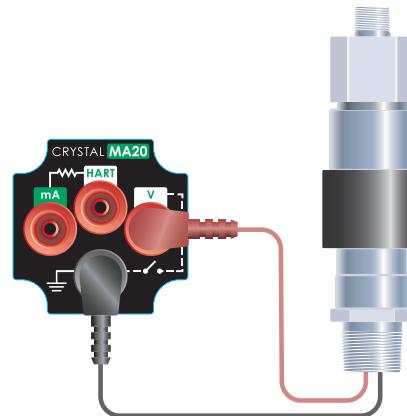
Voltage Mode

The nVision may be used to measure voltages up to 28VDC. Select the Voltage mode through the Setup menu to properly configure the nVision prior to connection and use. The illustration denotes the proper Voltage connection scheme to the MA20 module.



Switch Test Mode

The nVision may be used to detect switch closures. Select the Switch Test mode through the Setup menu to properly configure the nVision prior to connection and use. The illustration denotes the proper Switch Test connection scheme to the MA20 module.



Temperature (RTD100) Module Instructions

Your nVision has the ability to measure temperature very accurately if populated with an RTD100 module. With this system you may connect your resistance temperature detector (platinum RTD) or platinum resistance thermometer (PRT) to the nVision using the provided IP67 rated connector system (P/N: 3953). Once the sensing element is connected, you may display the temperature reading in your desired unit. The nVision can also measure electrical resistance (Ω) to help in troubleshooting your resistance based sensing element.

Temperature Coefficient of Resistance (TCR)

Your nVision comes pre-loaded with several common RTD sensing element TCR values with the appropriate Callendar-Van Dusen Coefficients to convert your resistance measurement to the appropriate temperature measurement. The available 100 Ω platinum RTD TCRs are:

- Pt100 (385) Euro
- Pt100 (3911) US
- Pt100 (3926)

CRYSTALCONTROL Simply select the desired TCR or coefficient values in CrystalControl for use on the nVision. You may also view the Summary page to confirm you have selected the correct setting for your sensing element..

Connecting your RTD to the RTD100 Module

Your nVision RTD100 module has been shipped with an IP67 rated, M8 connector (P/N: 3953). The terminal block based connector allows you to attach your RTD sensor for 2-, 3-, or 4-wire connections. Care must be taken to install the RTD connector shell properly to ensure the robust IP67 sealing.

1 RTD sensor element connection requirements:

a 100Ω Platinum RTD with:

- i TCR of 385, 3926, or 3911
- ii Cable diameter of 3.5 to 5.0 mm [0.14 to 0.2 inches] with smooth, continuous covering adequate for IP67 sealing.
- iii Stranded conductor cross section of 0.14mm² to 0.5mm² [0.0002 to 0.0008 in²].

2 For your ease in sourcing this connector, the following sources of supply may be used:

a Phoenix Contact:

- i Order Number: 1501265, or Part Number: SACC-M8MS-4CON-M-SM

b Binder:

- i Part Number 99-3383-100-04

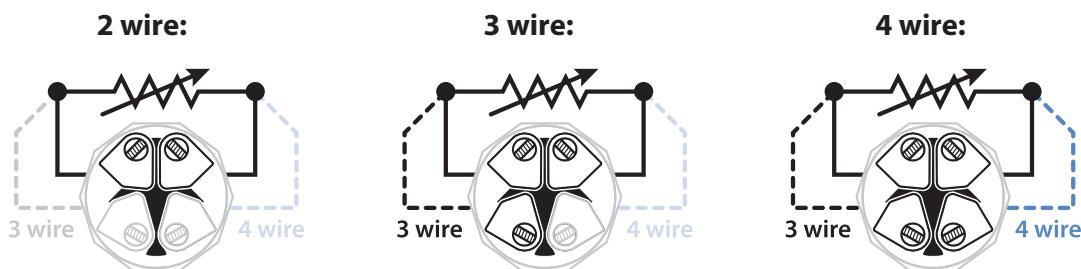
3 RTD sensor element cable preparation:

a Strip approximately 12.0 mm [0.5 in] outer insulation from RTD cable.

b Strip the individual RTD element sense wires approximately 4.0 mm [0.16 in].

c Install 3 piece sealing system (see Figure 1 below) onto the cable assembly. Take care to place parts in proper order and orientation.

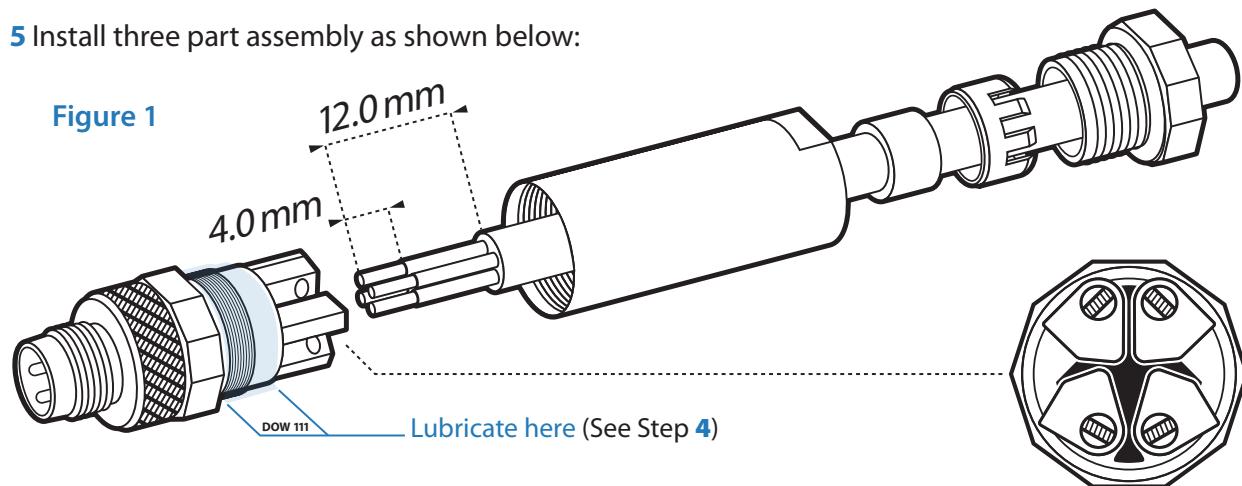
d Install your RTD sense element wires with the following wiring, and tighten set screw as required in the following manner:



e. Confirm correct orientation of element wires in connected state.

4. Lubricate o-ring and thread system (See Figure 1) with Dow 111 or equivalent in location near terminal block as required to prevent water intrusion when connector shell is installed. Thread shell in place until tight.

5 Install three part assembly as shown below:



6 Leak check to ensure water tight seal. If any leaking occurs, rework and lubricate as necessary. If leak-free, your RTD sensor is ready to use with the nVision Reference Recorder.

a Note: Your nVision has the RTD100 module TCR set to Pt100 (385) Euro. Modify this setting in **CrystalControl** if required.

Modifying the Base Resistance (R_0)

As with any measurement device, it is possible the sensor will drift over time or from extreme temperatures. The nVision allows a user defined offset to the 100Ω base resistance experienced at 0°C if needed to improve the performance of your sensor.

CRYSTALCONTROL This feature can be found in CrystalControl and can also be viewed under the Summary pages on the nVision product.

Resistance Temperature Detectors (RTDs)

Resistance Temperature Detectors (RTDs) are temperature sensors that contain a resistor that utilize the predictable change in electrical resistance of particular materials over temperature. Platinum elements have been used for many years in laboratories and industrial processes, and have a reputation for range, linearity, repeatability and stability. The selection strengths of RTDs, or sometimes called PRT (platinum resistance thermometer) are their wide temperature range (approximately -200°C to 850°C), accuracy (better than thermocouples), good interchangeability between similar sensors, and long-term stability. For further information about RTDs not covered in this section please refer to <http://www.wikipedia.org>.

Platinum RTD sensor element types have the following general feature set:

Element	Temperature Range	nVision (TCR) Temp. Coefficient of Resistance	Base Resistance	TCR ($\Omega/\Omega/^\circ\text{C}$)	Sensitivity (avg. $\Omega/^\circ\text{C}$, 0 to 100 $^\circ\text{C}$)
Platinum	-200 $^\circ\text{C}$ to 850 $^\circ\text{C}$ (-328 $^\circ\text{F}$ to 1562 $^\circ\text{F}$)	Pt100 (385) Euro	100 Ω at 0 $^\circ\text{C}$	0.00385	0.385
Platinum	-259 $^\circ\text{C}$ to 1235 $^\circ\text{C}$ (-434 $^\circ\text{F}$ to 2255 $^\circ\text{F}$)	Pt100 (3926) US	100 Ω at 0 $^\circ\text{C}$	0.003926	0.3926
Platinum	-259 $^\circ\text{C}$ to 630 $^\circ\text{C}$ (-434 $^\circ\text{F}$ to 1166 $^\circ\text{F}$)	Pt100 (3911)	100 Ω at 0 $^\circ\text{C}$	0.003911	0.3911

CRYSTALCONTROL nVision's RTD100 temperature module is designed to be used with 100 Ω platinum RTDs that can be wired in 2, 3, or 4-wire methodology. Default nVision setting is 3-wire, but this can be modified with CrystalControl to achieve the method that you prefer.

See Temperature Module (RTD100) Specifications for further information.

Callendar-Van Dusen Equation

The relationship between temperature and resistance is given by the Callendar-Van Dusen equation.

$$R_T = R_0 [1 + AT + BT^2 + CT^3 (T-100)] \text{ for } (-200^\circ\text{C} < T < 0^\circ\text{C})$$

$$R_T = R_0 [1 + AT + BT^2] \text{ for } (0^\circ\text{C} \leq T \leq \text{Upper Temperature Range listed below})$$

Where: R_T = the resistance at temperature, T; R_0 = the resistance at 0 $^\circ\text{C}$; and the constants A, B, and C dependent upon RTD selected (TCR).

nVision (TCR) Temp. Coefficient of Resistance	TCR ($\Omega/\Omega/^\circ\text{C}$)	Temperature Range	A ($^\circ\text{C}^{-1}$)	B ($^\circ\text{C}^{-2}$)	C ($^\circ\text{C}^{-4}$)
Pt100 (385) Euro	0.00385	-200 $^\circ\text{C}$ to 850 $^\circ\text{C}$ (-328 $^\circ\text{F}$ to 1562 $^\circ\text{F}$)	3.9083×10^{-3}	-5.7750×10^{-7}	-4.183×10^{-12}
Pt100 (3926) US	0.003926	-259 $^\circ\text{C}$ to 1235 $^\circ\text{C}$ (-434 $^\circ\text{F}$ to 2255 $^\circ\text{F}$)	3.9848×10^{-3}	-5.87×10^{-7}	-4.0×10^{-12}
Pt100 (3911)	0.003911	-259 $^\circ\text{C}$ to 630 $^\circ\text{C}$ (-434 $^\circ\text{F}$ to 1166 $^\circ\text{F}$)	3.9692×10^{-3}	-5.8495×10^{-7}	-4.2325×10^{-12}

System Measurement Uncertainties Possible with nVision

To understand the total system measurement uncertainty of the temperature measurement you must consider both the nVision and the RTD sensing element uncertainties utilized in the test application. Since the uncertainties of nVision and the sense element are independent of each other, they must be combined properly with the preferred square root of the sum of the squares¹ (or “root sum squares”) method.

The proper selection of the RTD sensing element is very important as the error associated with this device is the majority of the overall system measurement uncertainty. IEC 751 is the standard that defines the temperature versus resistance for 100Ω , $0.00385 \Omega/\Omega/\text{°C}$ platinum RTDs. IEC 751 defines two classes of RTDs: Class A and B. Class A RTDs operate over the -200°C to 650°C range versus -200°C to 800°C for the Class B elements. For example, the Class A uncertainty is about on half that of the Class B elements as illustrated in the following table.

Tolerance Class	Temperature Deviation	Accuracy at 0°C	Standard
Class A	$\pm(0.15 + 0.002*t)\text{°C}$	$100.00 \pm 0.06 \Omega$	DIN/IEC751
Class B	$\pm(0.3 + 0.005*t)\text{°C}$	$100.00 \pm 0.12 \Omega$	DIN/IEC751

1 Crystal Engineering recommends combining system expanded uncertainties in accordance with recommendations outlined in ISO “Guide to Expression of Uncertainty in Measurement (GUM). The uncertainties typically reported by Crystal Engineering represent expanded uncertainties using a coverage factor $k=2$ to approximate a 95% confidence level. The typical method of combining uncertainties is the root sum squares of the individual contributing uncertainties and will be calculated as such for the example shown.

Looking in detail at the use of Class B RTDs the following uncertainties are determined for the nVision, Class B RTD sensing element, and the System at sample temperatures:

Temperature °C	nVision Uncertainty $\pm\Omega$	nVision Uncertainty $\pm\text{°C}$	RTD/Class B Uncertainty $\pm\Omega$	RTD/Class B Uncertainty $\pm\text{°C}$	System Uncertainty $\pm\Omega$	System Uncertainty $\pm\text{°C}$
-200	0.02	0.05	0.56	1.30	0.56	1.30
0	0.04	0.09	0.12	0.30	0.12	0.31
200	0.05	0.13	0.48	1.30	0.48	1.31
400	0.06	0.17	0.79	2.30	0.79	2.31
600	0.07	0.21	1.06	3.30	1.06	3.31
800	0.08	0.25	1.28	4.30	1.28	4.31

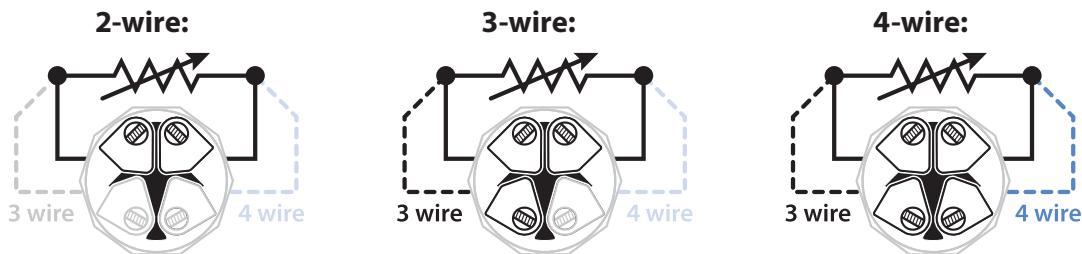
As mentioned above, the System Uncertainties are calculated using the root sum squares method:

$$U_{\text{system}} = \sqrt{U_{\text{RTD100}}^2 + U_{\text{RTD Sensor Element}}^2}$$

2-, 3-, or 4-Wire Measurements

In order to measure temperature, the RTD sensing element must be connected through the IP67 rated, M8 connector (P/N 3953) provided with your RTD100 module. Since the temperature measurement is based on the sensing element resistance, any other resistance in the system (lead wire, connections, etc) may be added to the measurement circuit and will result in measurement error. Care must be taken to eliminate the effects of any unwanted resistance in order to ensure the best possible measurements.

The three wiring methods are:



In the 2-wire method, the sensor resistance measurement includes the lead wire resistance. This method is typically used only when lead wires are very short, or when high measurement accuracy is not required.

In the 3-wire method, two lead wires connect to one side of the RTD sense element while the third lead connects to the other side. The two adjoining lead wires cancel each other out allowing the nVision to read the RTD sense element without the associated lead resistance measurement error. This self canceling resistance value is also subtracted from the other leg with the assumption that the two are equal.

Your nVision is also capable of 4-wire measurements. The fourth wire allows the other side of the lead wire to self cancel independently, thus reducing your measurement uncertainty to a greater level.

CRYSTALCONTROL It is also necessary to ensure that your nVision is properly configured in CrystalControl to the proper RTD Lead Type present. You can validate your nVision setting in the Summary menu item under the Settings button. The following matrix applies if your nVision Lead Type setting and the actual wiring of your RTD sense element do not match.

		RTD Sense Element Wired Into M8 Connector (PN/3953)		
		2-wire	3-wire	4-wire
CrystalControl Lead Type Setting	2-wire	Valid 2-wire data	Valid 2-wire data	Valid 2-wire data
	3-wire	Invalid data	Valid 3-wire data	Valid 3-wire data
	4-wire	Invalid data	Invalid data	Valid 4-wire data

Differential Mode (Pressure and Temperature)

Upper, Lower, Tare and Differential Reading

The Differential Mode screen has several key features that will help you take quality pressure and temperature measurements. ΔP can be measured if your nVision is populated with two PM modules. Conversely, ΔT can be measured if your nVision is populated with two RTD100 modules.

► Upper and Lower Readings

Both the Upper and Lower sensor readings are filtered and offer a dampened view of your data.

► Tare

Using the Tare function will improve your measurement uncertainty significantly if used properly. The Tare function allows you to equalize (normalize) the nVision measurements of the two modules at a non-ambient datum. The Tare reading will display in the same units as the main ΔP or ΔT reading.

To Tare, simply press the  button until the display briefly flashes all dashed lines (----). To clear the Tare value in the Differential Mode, hold the  button for 3 seconds until the main display readings change from (----) to (--).

► Differential Readings

Differential Pressure: The Tare function allows you to equalize (normalize) the differential pressure at a high static line pressures to improve your measurement accuracy. Therefore, if you apply the same static line pressure signal to both sensors simultaneously, you should have a ΔP reading of zero. Due to the allowable tolerance or error for each module from true applied at elevated pressures, the ΔP reading may have a value other than zero. The Tare function allows you to normalize both of these readings so that the ΔP reading is zero. Therefore, you will have a much more accurate ΔP reading than you normally would have if this process was not completed.

The Tare should be reestablished every time you are at a new static line pressure, including vent condition. For instance if your ΔP reading has 8 inH20 of Tare at 1500 PSI static, when you return to vent condition this 8 inH20 of Tare will remain in place on your ΔP reading until cleared with the  button.

Differential Temperature: The Tare function also allows you to equalize the differential temperature or resistance measurements to improve your measurement accuracy. Therefore, if you apply the same temperature or resistance signal to both RTD100 sensor elements simultaneously you should have a ΔT reading of zero. Due to the allowable tolerance or error for each module from true applied at different temperatures, the ΔT reading may have a value other than zero. The Tare function allows you to normalize both of these readings so that the ΔT reading is zero. Therefore, you will have a much more accurate ΔT reading than you normally would have if this process was not completed. Note that generally accepted lab practices should be followed when trying to establish a common temperature measurement on two independent sensors.

The Tare should be reestablished every time you are at a new temperature or resistance. For instance if your ΔT reading has 0.2°C of Tare at 220°C, when you return to ambient conditions this 0.2°C of Tare will remain in place on your ΔT reading until cleared with the  button.

► Measurement Uncertainties for two Pressure (PM) Modules using Tare Function

The Tare function can improve measurement uncertainties on **two modules with the same full scale pressure range** installed into one nVision Reference Recorder.

The following specifications apply to the measurement system:

Full Scale Range of Both Sensors		The greater of					
		PSI	PSI	mbar	inH2O	or	% of DP Reading
		30	0.0015	0.10	0.042		0.025%
		100	0.0040	0.28	0.11		0.025%
		300	0.015	1.0	0.42		0.025%
		1 000	0.04	2.8	1.1		0.05%
		3 000	0.15	10.3	4.2		0.05%
		10 000	0.4	27.6	11.1		0.1%

Due the additional digit of resolution in differential mode some units may be inappropriate due to the noise floor of the reading.

The following chart indicates the expected resolution on the appropriate units:

PSI	bar	kPa/MPa	kg/cm ²	PSI	kg/cm ²	inHg	inH ² O	mmHg	mmH ² O	kPa	bar	mbar	MPa
30	3	300	3	0.0001	0.00001	0.0001	0.001			0.001	0.00001	0.01	
100	10	1	10	0.0001	0.00001	0.001	0.01			0.001	0.00001	0.01	
300	30	3	30	0.001	0.0001	0.001	0.01			0.01	0.0001	0.1	0.00001
1 000	100	10	100	0.01	0.0001	0.01	0.1			0.01	0.0001	0.1	0.00001
3 000	300	30	300	0.01	0.001	0.01				0.1	0.001		0.0001
10 000	700	70	700	0.1	0.001					0.1	0.001		0.0001

► Measurement Uncertainties for two Pressure (PM) Modules without Tare

The total nVision Reference Calibrator measurement uncertainty in the ΔP mode configuration will need to consider the uncertainties of both pressure modules. Crystal Engineering recommends the module uncertainties to be combined with the preferred square root of the sum of the squares (or “root sum squares”) method.

The following table lists the possible combinations of combining Pressure Modules (PM) with different accuracy statements. The uncertainties reported below are **without** using the Tare feature which will greatly improve your measurement uncertainty.

Lower Pressure Module Uncertainties (of Static Line Pressure) (of Reading)	Upper Pressure Module Uncertainties (of Static Line Pressure) (of Reading)		
	0.025%	0.05%	0.10%
	0.025%	0.035%	0.056%
Lower Pressure Module Uncertainties (of Static Line Pressure) (of Reading)	0.05%	0.056%	0.071%
	0.10%	0.103%	0.112%
			0.141%

► Measurement Uncertainties for two Temperature (RTD100) Modules without Tare

The RTD100 module is capable of both temperature and resistance measurements. The resistance measurement uncertainty can be calculated by combining the uncertainties of the two Resistance measurements. The following table describes the combined uncertainty of two RTD100 Module resistance measurements. The uncertainty below is reported are without using the Tare feature which will greatly improve your measurement uncertainty as stated above.

		Upper RTD100 Module Uncertainties (of Reading + Ω)
		0.015% + 0.02 Ω
Lower RTD100 Module Uncertainties (of Reading + Ω)	0.015% + 0.02 Ω	0.021% of Rdg + 0.03 Ω

To calculate the total uncertainty of the differential temperature measurement ($U_{\Delta T}$) you must combine the uncertainties of each the upper and the lower RTD100 and RTD sensor element systems (U_{system}).

Calculate U_{system} for both the upper and lower RTD100 and RTD sensor element systems:

$$U_{system} = \sqrt{U_{RTD100}^2 + U_{RTD\ Sensor\ Element}^2}$$

Calculate the total differential pressure uncertainty by the following method:

$$U_{\Delta T} = \sqrt{U_{system\ upper}^2 + U_{system\ lower}^2}$$

► Measurement Uncertainties for two Temperature (RTD100) Modules with Tare

To determine the improved Tare function uncertainties it may be necessary to conduct an analysis of the application. A suggested method of analysis is to Tare the ΔT reading when measuring the isolated temperature at site A. Without resetting the Tare, measure the isolated site B temperature and determine the error in your ΔT reading. Comparing these results would represent the full range of Δt readings that you would see in your application.

Module Installation Instructions

The nVision's upper and lower bays allow for removal of modules in the field. All module changes should be completed in a dry, clean environment (out of the outdoor elements). Proper electrostatic discharge (ESD) grounding techniques should be taken into account prior to the module change over. If you desire to remove a module without installing a replacement, a module blank plate (P/N: BNKPLT) must be installed to ensure your IP67 rating and to protect the product.

WARNING: Do not install two MA20 modules simultaneously as it may permanently damage your nVision.

CAUTION: Do not proceed unless you have a suitable replacement module or blank plate for the module bay in question.

The following steps must be performed sequentially to properly complete the module change:

- 1 **CRYSTALCONTROL** Before removing or replacing any modules, ensure that all recorded data has been archived properly through the use of **Export Data** in CrystalControl.
- 2 Place nVision on clean stable work surface. Clean exterior of the product, if necessary, to ensure no moisture or foreign matter will enter the enclosure when disassembled. Use of proper ESD grounding techniques is highly encouraged to prevent damage to the exposed module.
- 3 **nVision Reference Recorder:** Turn off nVision with the  (power) button, then remove the 4AA battery pack from the rear of the unit.
nVision Lab Reference: Turn off nVision with the  (power) button, then disconnect the power cord from the AC power source.
- 4 Remove any USB power connection from the nVision chassis during module installation.
WARNING: Failure to disconnect nVision from 4AA, USB or AC power before module removal installation may cause damage.
- 5 Using a Torx T10 wrench, loosen the four screws retaining the module face plate and carefully pull the module out. Avoid twisting the module when removing from the nVision.
Note: Some modules may be difficult to remove due to the physical form and the IP67 sealing strategy employed. It may be necessary to connect a fitting or RTD cable to the appropriate module in order to gain better gripping power for removal. Never force the separation of a module from an nVision chassis.
- 6 Note the correct orientation of module connector on rear of module (located up or closest toward the display) in relation to the nVision chassis during removal. Place the removed nVision module in the ESD bag for safe protection.
- 7 Install new module in similar orientation as one removed in step 2 (rear module connector facing up to keypad of nVision). If improperly oriented the tri-lobe design of the module will not allow proper installation. Do not force installation of the module as permanent damage may occur. Ensure light lubrication of the module's unique quad-lobe o-ring (P/N: 4110) with Dow 111 silicon lubricant or equivalent to ensure an IP67 rated seal.
Note: If installing blank plate, instead of module, ensure part is oriented flat and evenly within the module bay for proper sealing.
- 8 Tighten face plate or blank plate screws to **50 in-oz (0.35 newton meter (N-m)) torque (T10 Torx)**.
- 9 Replace 4AA power module and tighten adequately to ensure IP67 seal. When power is first applied by the battery pack, the unit will automatically turn on. Ensure that nVision recognizes the new module by confirming in CrystalControl or the Summary screens.
- 10 Before using the nVision to record, **Erase All Data** using **setup** button **Recording/Erase All Runs** menu items.
- 11 nVision is now ready to use. If you have any problems during this process, check the Troubleshooting section for relevant information or contact Crystal Engineering at www.crystalengineering.net or (805) 595-5477.

nVision Application Specific Test Strategies

The nVision may be used for the following typical test applications.

Transmitter Calibration (Pressure versus Current)

The nVision is capable of calibrating a pressure transmitter:

1 Modules Required: PM (Pressure) and MA20 (Current & Voltage).

2 Determine if HART transmitter is present. If yes, then proceed to HART Transmitter Calibration (Pressure versus Current) section.

3 Select desired Current mode (mA, or % 4 – 20mA) using the Setup button.

4 Change the nVision to the Dual Numerical Screen or any other preferred screen view.

5 Select the proper pressure units for your nVision using the Setup menu.

6 Connect the nVision as shown.

7 Vent pressure source and Zero (----) the nVision pressure module.

8 Apply pressure profile. Test or record pressure and current readings as required.

9 Before disconnecting the nVision, isolate and vent the pressure system.

Disconnect and return to service.



HART Transmitter Calibration (Pressure versus Current)

The nVision is capable of calibrating a pressure transmitter:

- 1 Modules Required: PM (Pressure) and MA20 (Current & Voltage).
- 2 Determine if HART transmitter is present.
If not, then proceed to Transmitter Calibration (Pressure versus Current) section.
- 3 Select desired Current mode (mA, or % 4 – 20mA) using the Setup button.
- 4 Change the nVision to the Dual Numerical Screen or any other preferred screen view.
- 5 Select the proper pressure units for your nVision using the Setup menu.
- 6 Connect the nVision as shown.
- 7 Vent pressure source and Zero (----) the nVision pressure module.
- 8 Apply pressure profile. Test or record pressure and current readings as required.
- 9 Before disconnecting the nVision, isolate and vent the pressure system. Disconnect and return to service.



Transmitter Calibration (Pressure versus Voltage)

The nVision is capable of calibrating a pressure transmitter:

- 1 Modules Required: PM (Pressure) and MA20 (Current & Voltage).
- 2 Select the Voltage mode using the Setup button.
- 3 Change the nVision to the Dual Numerical Screen or any other preferred screen view.
- 4 Select the proper pressure units for your nVision using the Setup menu.
- 5 Connect the nVision as shown.
- 6 Vent pressure source and Zero (----) the nVision pressure module.
- 7 Apply pressure profile. Test or record pressure and voltage readings as required.
- 8 Before disconnecting the nVision, isolate and vent the pressure system, disconnect and return to service.



Switch Test (Pressure versus Switch Closure)

The nVision is capable of testing a pressure switch :

- 1 Modules Required: PM (Pressure) and MA20 (Current & Voltage).
- 2 Select the Switch Detection mode using the Setup button.
- 3 Change the nVision to the Switch Test screen view.
- 4 Select the proper pressure units for your nVision using the Setup menu.
- 5 Connect the nVision as shown.
- 6 Vent pressure source and Zero (----) the nVision pressure module.
- 7 Slowly apply pressure until the switch changes state (open or closed). Note the displayed value for this state change.
- 8 Slowly reduce pressure until the switch changes state again on the display (open or closed).
- 9 Before disconnecting the nVision, isolate and vent the pressure system. Disconnect and return to service.



Differential Pressure (Pressure versus Pressure)

The nVision is capable of measuring differential pressures:

1 Modules Required: Two pressure modules

- a** Note that you do not need the same pressure ranges on the two pressure modules but this will affect your calculated system uncertainty.
- b** Validate that both pressure modules have a pressure rating exceeding your static line pressure.

2 Zero the pressure modules under vent condition in your desired units.

This must be done through the single numerical display screens.

Note: To obtain the best results use piping or hoses with equivalent lengths and diameters.

3 Change the display to the Differential Screen. This screen is automatically activated when two similar modules are present.

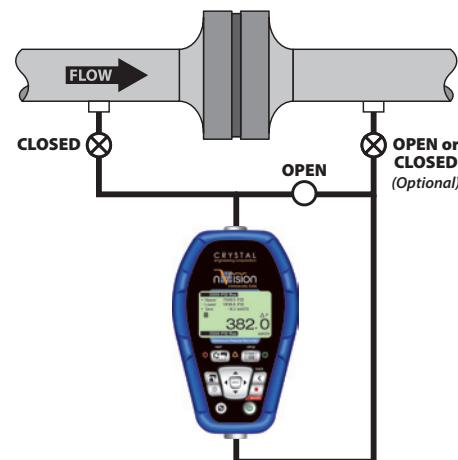
4 Select the desired units for your static (upper and lower module) and differential pressures using the Setup menu.

5 Using the valve setup shown, equalize the upper and lower pressure modules to the downstream static pressure. You may find it beneficial to isolate this downstream equalization pressure from the main pressure line to minimize any dynamic issues. Equalize or Tare the two nVision modules by pressing the  button until (----) appears.

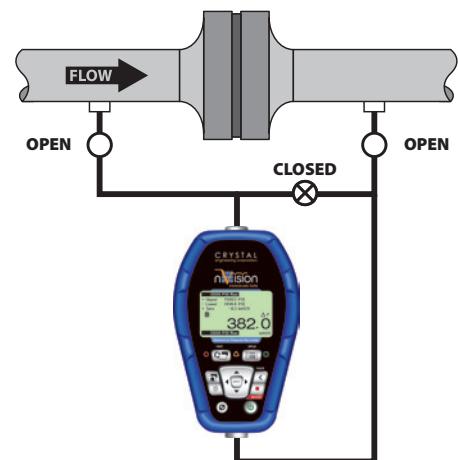
6 Isolate the upper sensor from the lower sensor using the valve system. Take or record pressure readings as necessary.

7 Before disconnecting the nVision, isolate and vent the nVision pressure system, disconnect and return to service.

Equalization



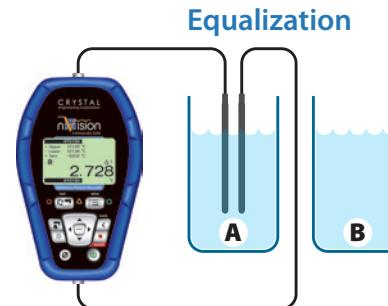
Differential Pressure



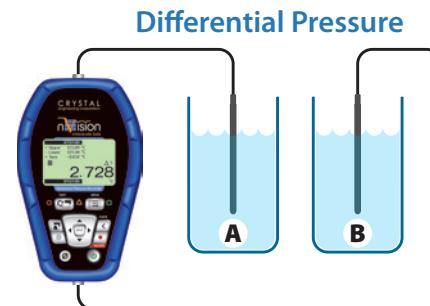
Differential Temperature (Temperature versus Temperature)

The nVision is capable of measuring differential temperature:

- 1 Modules Required: Two RTD100 temperature modules.
- 2 Change the display to the Differential Screen. This screen is automatically activated when two similar modules are present.
- 3 Select the desired units for your upper and lower modules and differential temperature using the Setup menu.
- 4 Connect the nVision as shown.
- 5 You may equalize or TARE both RTD100 sensor elements by subjecting them to the same temperature source (ex: source A). The TARE may be implemented by pressing the  button until (----) appears. To ensure that you are subjecting both sensor elements to the same temperature source it may be necessary to swap locations to determine their repeatability. As with all temperature measurement, adequate mixing of the media is essential for quality measurements.
- 6 Move your RTD100 sense elements to your target locations (ex: source A and B) and take or record temperature readings as necessary.
- 7 Before disconnecting the nVision, isolate, disconnect and return to service.



Temperature:
Source A < Source B



Calibration

If adjustment is required, we recommend returning the nVision or separate modules to the factory. Factory service offers benefits you won't find anywhere else. We have the A2LA accredited Calibration Laboratory facilities to test your nVision Reference Recorder at a variety of temperatures utilizing NIST traceable standards, resulting in calibration certificates that provide performance data over temperature. Furthermore, upgrades may be available to add or enhance operating features. We designed the product to last, and we support it so that you can get the most from your investment.

Under normal operating conditions, we recommend the nVision be calibrated on an annual basis. Your quality system may require more or less frequent calibration, or your experience with the gauge, or operating environment may suggest longer or shorter intervals.

Although we prefer that you return the nVision to Crystal Engineering for calibration, ordinary recertification and/or adjustments may be performed by any qualified personnel with appropriate training and equipment. The following instructions are ONLY intended for such qualified personnel with appropriate test equipment. We recommend that the calibration standards used have a minimum rated accuracy of 0.008% of reading, or equivalent in terms of percent of full scale. This level of accuracy requires the use of piston (deadweight) gauges or very high performance pressure controllers.

CRYSTALCONTROL There are no internal potentiometers. The nVision contains a "span" factor (userspan), set to approximately 1 (as shipped from the factory). As components age this may need to be changed to a value slightly higher or lower, to slightly increase or decrease all readings. This adjustment can be made with a computer through CrystalControl.

CRYSTALCONTROL **Calibration for Pressure Modules (PM):** "Zero" the nVision, then record displayed pressure for two or more pressure points. Determine if the nVision would benefit from an overall increase or decrease of the indicated pressures. Adjust userspan accordingly and validate results.

CRYSTALCONTROL **Calibration for Current, Voltage & Switch Test Module (MA20):** The MA20 can be calibrated through the use of the span factor (userspan) and the Offset for the current and voltage modes. Record displayed current or voltage for two or more points. Determine if the nVision would benefit from an overall increase or decrease of the indicated reading and modify using the userspan and offset feature of CrystalControl.

To calibrate the Switch Test, use the CrystalControl Calibration Wizard. Install your red and black test leads into the Switch Test locations as shown in the wizard. Ensure that the leads are not connected together forming a closed circuit. After pressing 'start' the application will survey the circuit in the open state. When prompted by "Waiting for switch to close..." connect the red and black test leads together creating a closed circuit. The application will survey the circuit in the closed state. After this process the switch test will be fully functional and ready to use.

CRYSTALCONTROL **Calibration for Temperature Modules (RTD100):** The RTD sensor can be calibrated through the use of the span factor (userspan) and the Base Resistance (Ro) at 0°C. Record displayed temperature for two or more temperature points. Determine if the nVision would benefit from an overall increase or decrease of the indicated temperatures and modify using the userspan feature in CrystalControl. It is also possible to modify the RTD sensor resistance reading at 0°C to a custom value other than the default value of 100 Ω using the Base Resistance (Ro) at 0°C in CrystalControl. Note, however, that the Ro offset will affect all RTDs used with the nVision and should be used with care.

nVision Reference Recorder Product Specifications



Model Numbering System



Temperature (Operating and Storage)

Operating & Compensated.....-20°C to 50°C (4°F to 122°F).

Storage..... -40°C to 75°C (40°F to 167°F).

Humidity

Temperature Range Humidity

-20 to 10°C Uncontrolled

10 to 30°C..... 0 to 95% Relative

30 to 40°C..... 0 to 75% Relative

40 to 50°C..... 0 to 45% Relative

IP Rating

IP67 rated enclosure (1m immersion for 30 min) per ISO 60529

Electrical Connection

Electrical Connection mini-USB B (environmentally sealed chassis connector).

nVision under USB power consumes less than 100 mA.

WARNING: The mini USB B connector shall not be used within the hazardous atmosphere. It shall be used in the non-hazardous atmosphere with either "Safety Extra Low Voltage Circuits" (SELV) or "Protective Extra Low Voltage Circuits" (PELV). The USB connector has a Um of 6V.

SELV and PELV definitions per IEC60079-11 are:

Safety extra-low voltage (SELV): Extra-low voltage system (i.e. normally not exceeding 50 VAC or 120 V ripple-free DC) electrically separated from earth and from other systems in such a way that a single fault cannot give rise to an electrical shock.

Protective extra-low voltage (PELV): Extra-low voltage system which is not electrically separated from earth but which otherwise satisfies the requirements for SELV. Note: A 50V center-tapped earth system is a PELV system.

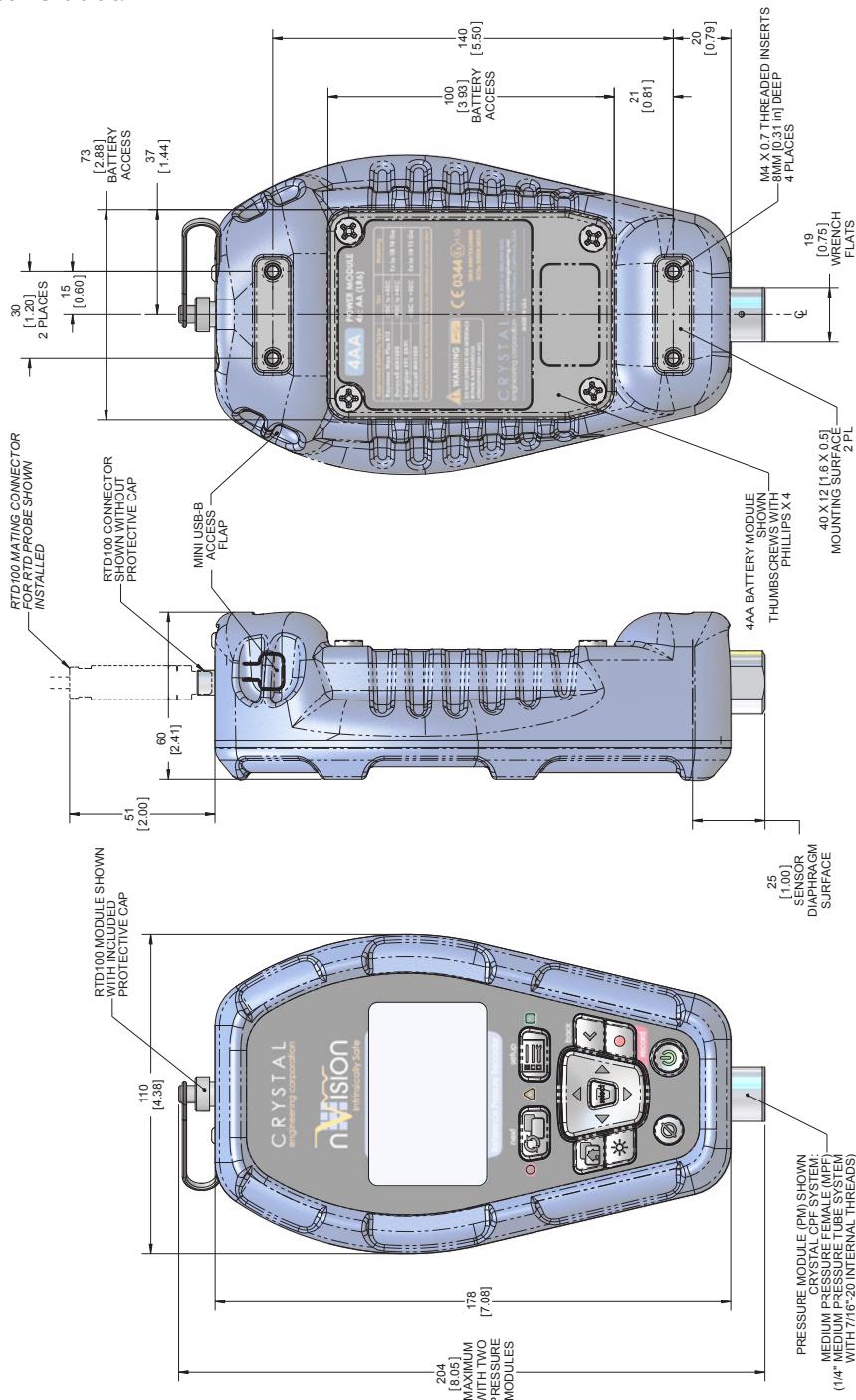
Mounting

Permanent Mounting four M4 x 0.7 threaded inserts (8mm deep)
(see drawing for location)

Enclosure

Impact resistant injection molded housing and elastomeric protective boot compatible with common industrial fluids, including Skydrol.

Weight: 680g (1.5 lbs) including one each PM and RTD100 module, 4AA battery module, and protective boot.



ALL DIMENSIONS ARE IN MILLIMETERS (INCHES)

nVision Lab Reference Product Specifications



Model Numbering System



Temperature (Operating and Storage)

Operating & Compensated..... 10°C to 50°C (50°F to 122°F).

Storage..... 0°C to 75°C (32°F to 167°F).

Humidity

<95% Relative, non-condensing

IP Rating

IP40 rated enclosure per ISO 60529

Electrical Connection

Electrical Connection (Communication) mini-USB B.

Electrical Connection (Power):. 100-240VAC, 50-60 Hz with international plug adapters.

WARNING: nVision Lab Reference shall not be used within hazardous atmospheres.

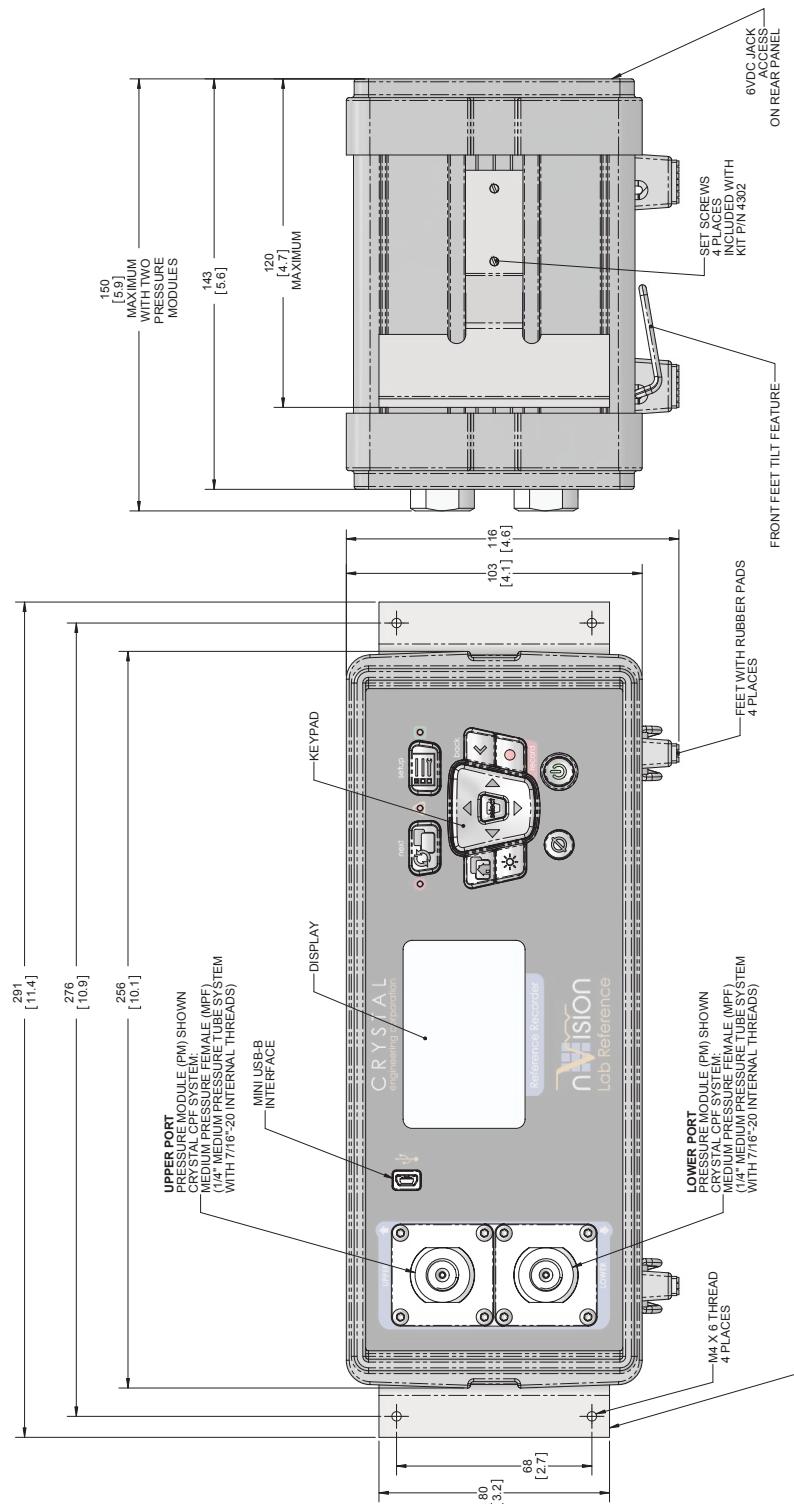
Mounting

Rack Mount Kit two rack mount ears with hardware.

Enclosure

Enclosure: Powder coated metal enclosure.

Weight:..... 2.2 kg (4.75 lbs) including two pressure modules.



nVision Serial Numbers

Serial Number Location

Each product has a maximum of three serial numbers, one for the chassis and each of the modules (upper and lower). Chassis serial numbers are located in the power bay or on the rear of the product in the case of the Lab Reference. Module serial numbers are located on the module and can also be viewed in the power bay of the Reference Recorder.

 All serial numbers can be viewed using the nVision Summary screens or in CrystalControl.

Serial Numbering System

Serial Numbers consist of 6 numbers, with the left most digit representing the year of manufacture. For example: 937834 was manufactured during 2009.

Module Specifications

Accuracy specifications include all effects of linearity, hysteresis, repeatability, temperature and stability within the specified operating temperature range for one year.

Exposure to environmental extremes of temperature, shock and/or vibration may warrant a more frequent recertification period.

Pressure Module (PM) Specifications

► Accuracy

30 to 100% of Full Scale . . . $\pm(0.025\% \text{ of Reading})$, $\pm(0.05\% \text{ of Reading})$, or $\pm(0.1\% \text{ of Reading})$

0 to 30% of Full Scale $\pm(0.0075\% \text{ of Full Scale})$, $\pm(0.015\% \text{ of Full Scale})$, or $\pm(0.03\% \text{ of Full Scale})$

See **Accuracies, Ranges and Resolutions** charts for the appropriate accuracy statement for your module.

PM modules must be exercised whenever exposed to significant changes in environmental conditions to achieve these specifications, and re-zeroed. To exercise a gauge, cycle the gauge between zero (ambient barometric pressure) and the pressure of interest.

A properly exercised gauge will return to a zero reading (or return to the same ambient barometric reading).

CAUTION: Pressure Modules (PM) are not recommended for continuous use at high vacuum.

► Accuracy in Differential Pressure Mode:

Using the Tare function on a Differential Pressure Measurement when two pressure modules of the same full scale pressure range, the following accuracy statement applies:

Full Scale Range of Both Sensors	PSI	The greater of				% of DP Reading
		PSI	mbar	inH2O	or	
		30	0.0015	0.10	0.042	0.025%
		100	0.0040	0.28	0.11	0.025%
		300	0.015	1.0	0.42	0.025%
		1 000	0.04	2.8	1.1	0.05%
		3 000	0.15	10.3	4.2	0.05%
		10 000	0.4	27.6	11.1	0.1%

► Logging Interval

Fastest Logging Interval 10 readings per second

► Media Compatibility

Liquids and gases compatible with sensor and CPF fitting system:

Wrench-tight: 316 Stainless Steel

Finger-tight: 316 Stainless Steel and Viton (internal MPF o-ring)

► Connection

Crystal CPF System: Medium Pressure Female (MPF) (1/4" medium pressure tube system with 7/16-20 threads). See Crystal Engineering's CPF Brochure for further information.

CPF o-ring size and material: AS568A-012, Viton 90 durometer.

CAUTION: To achieve CPF maximum allowable working pressures no o-ring substitutions are allowed. See Crystal Engineering's CPF brochure and CES-003 CPF Safety Guide available from the website at <http://www.crystalengineering.net> for further detail.

► User Defined Units

 nVision gives you the ability to create your own custom User Defined Unit based on pressure. Implement your slope (user factor) and offset (offset factor) in CrystalControl. See CrystalControl application and manual for details.

► Pressure Conversions

1 PSI = 27.6806 inches of water column (water at 4°C [39.2°F])

27.7070 inches of water column (water at 15.6°C [60°F])

27.7292 inches of water column (water at 20°C [68°F])

2.03602 inches of mercury (mercury at 0°C [32°F])

51.7149 millimeters of mercury (mercury at 0°C [32°F])

703.087 millimeters of water column (water at 4°C [39.2°F])

0.070307 kilograms per square centimeter

68.948 millibar

6.8948 kilopascals

0.068948 bar

0.006895 MPa

► Accuracies, Ranges and Resolutions

	PSI	bar	kPa/MPa	kg/cm ²	Overpressure	PSI	kg/cm ²	inHg	inH2O *	mmHg	mmH2O	kPa	bar	mbar	MPa	
0.025% of Reading modules (30-100% of Full Scale)	30PSI	3BAR			3.0 x	0.001	0.0001	0.01	0.01	1	0.01	0.0001	0.1	0.0001	0.1	
		300KPA			3.0 x	0.001	0.0001	0.01	0.01	1	0.01	0.0001	0.1	0.0001	0.1	
	100PSI	10BAR			3KG	3.0 x	0.001	0.0001	0.01	0.01	1	0.01	0.0001	0.1	0.0001	0.1
		1MPA			2.0 x	0.001	0.0001	0.01	0.1	0.1	0.01	0.0001	0.1	0.0001	0.1	
	300PSI	30BAR			10KG	2.0 x	0.001	0.0001	0.01	0.1	1	0.01	0.0001	0.1	0.0001	0.1
		3MPA			2.0 x	0.01	0.001	0.01	0.1	0.1	0.01	0.0001	0.1	0.0001	0.1	
	1KPSI	100BAR			30KG	2.0 x	0.01	0.001	0.01	0.1	0.1	0.001	1	0.0001	1	
		10MPA			2.0 x	0.1	0.001	0.1	0.1	0.1	0.01	0.0001	1	0.0001	1	
	3KPSI	300BAR			100KG	2.0 x	0.1	0.001	0.1	0.1	0.1	0.001	0.0001	0.0001	0.0001	
		30MPA			1.5 x	0.1	0.01	0.1	0.1	0.1	0.01	0.0001	0.0001	0.0001	0.0001	
0.05% of Reading modules (30-100% of Full Scale)	10KPSI	700BAR			300KG	1.5 x	0.1	0.01	0.1	0.1	1	0.01	0.0001	0.0001	0.0001	
		70MPA			1.5 x	1	0.01	0.1	0.1	1	0.01	0.0001	0.0001	0.0001	0.0001	
	10KPSI	700BAR			700KG	1.5 x	1	0.01	0.1	1	0.01	0.0001	0.0001	0.0001	0.0001	
0.1% of Reading modules (30-100% of Full Scale)	10KPSI	700BAR			300KG	1.5 x	0.1	0.01	0.1	1	0.01	0.0001	0.0001	0.0001	0.0001	
		70MPA			1.5 x	1	0.01	0.1	0.1	1	0.01	0.0001	0.0001	0.0001	0.0001	
	10KPSI	700BAR			700KG	1.5 x	1	0.01	0.1	1	0.01	0.0001	0.0001	0.0001	0.0001	

* Density of water can be set to 4°C, 60°F or 20°C/68°F with CrystalControl software.

These **pressure ratings** also serve as **part numbers** when ordering nVision pressure modules.

For instance, the part number for nVision with a **RTD100 temperature module** in the **upper bay** and a **30MPa pressure module** in the **lower bay** would be:

NV-4AA-RTD100-30MPA (see Module Numbering System on page 25).

Differential Pressure Mode adds one digit of resolution to each unit. Not all units are appropriate for DP measurement due to noise floor. See [Differential Pressure section](#) for details.

Current, Voltage & Switch Test (MA20) Specifications

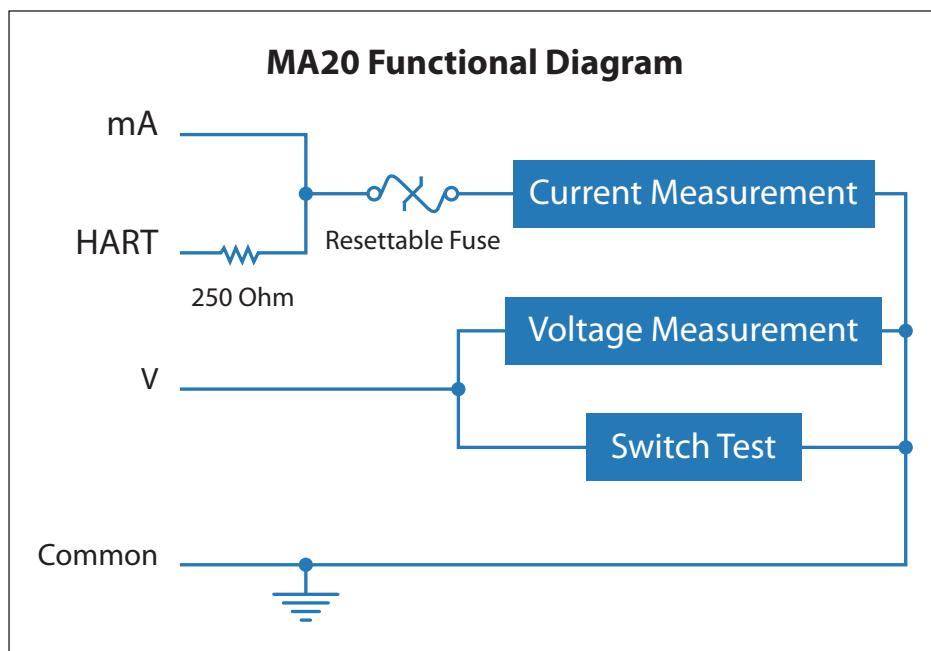
General

Modes		
Current	mA	% 4 - 20
Current with HART Resistor	mA	% 4 - 20
Voltage	V	
Switch Detection	Open	Closed

► Connection

2mm banana jacks for sheathed plugs, 12.7mm (0.5 in) spacing

► Terminals



► Logging Interval

Fastest Logging Interval. 6 readings per second.

► Entity Parameters

The MA20 Module has these specific input entity parameters:

$U_i = 28 \text{ V}$	$U_o = 6.6 \text{ V}$
$I_i = 93.3 \text{ mA}$	$I_o = 4.45 \text{ mA}$
$P_i = 653.3 \text{ mW}$	$P_o = 7.34 \text{ mW}$
$C_i = 0.36 \mu\text{F}$	$C_o = 0.5 \mu\text{F}^{**}$
$L_i = 39.1 \mu\text{H}$	$L_o = 12 \mu\text{H}^*$

*Total cable inductance between all modules

**Dependent on the supply to the terminals but shall not be greater than 0.5 μF

Current (mA) Input

► Accuracy

±(0.015% of reading + 0.002mA)

► Ranges, Resolutions and Units

Range 0 to 25mA

Max Allowable Current 55mA

Note: Inputs protected by resettable fuse

Resolution 0.001mA or 0.00%

Units mA, % 4-20

► mA Input

Input Resistance < 17.2 Ω

Voltage Burden @ 20mA < 0.35 V

► HART mA Input

HART Resistance 250 Ω

Voltage (V) Input

► Accuracy

±(0.015% of reading + 0.002VDC)

► Ranges, Resolutions and Units

Range 0 to 28VDC

Max Allowable Voltage 30VDC

Resolution 0.001VDC

Units VDC

Switch Test

► Switch Detection

Switch States Dry Contact

Closed State Resistance < 10 Ω

Open State Resistance > 10 MΩ

Temperature Module (RTD100) Specifications

► Accuracy

0% to 100% of Full Scale $\pm(0.015\% \text{ of reading} + 0.02\Omega)$

► Ranges, Resolutions and Units

Range 0 to 400 Ω for use with 100 Ω PRT (platinum resistance temperature detectors)

Resolution 0.01 on all scales

Units $^{\circ}\text{C}$, K, $^{\circ}\text{F}$, R, and Ω

► Wiring Types and TCRs

Wiring Types: 2-, 3-, or 4-wire

Available TCR Selections: 0.00385, 0.003911, 0.003926

► Connection

RTD Sensor Connector Interface:

P/N 3953: RTD Connection Kit (one IP67 terminal block connector)

(equivalent to Phoenix Contact Order Number: 1501265, or

Part Number: SACC-M8MS-4CON-M-SM, or Binder P/N: 99-3383-100-04)

Cable Diameter 3.5 to 5.0mm [0.14 to 0.012 in] with smooth, continuous covering adequate for IP67 sealing

Stranded Conductor Cross Section 0.14 to 0.5mm² [0.0002 to 0.0008 in²]

► Logging Interval

Fastest Logging Interval 5 readings per second.

Although nVision logging interval may be set to a faster rate, the RTD100 module will update the temperature reading at 2 readings per second or less.

► Entity Parameters

The RTD100 module has these specific input entity parameters:

Ui = 0 Uo = 9.73 V

li = 0 Io = 1.6642 V

Pi = 0 Po = 1.1 W

Co = 0.5 uF

Lo = 12 uH*

*Total cable inductance between all modules

Power Module (4AA) Specification

► Power

Batteries..... Four (4) size AA (LR6) batteries.

Warning: Do not remove or change the batteries in a hazardous atmosphere.

Approved batteries - The nVision is Intrinsically Safe only if powered by one of the following battery types:

Approved Battery Type	Ta=	Marking
Rayovac Max Plus 815	-20C to +50C	
Duracell MN1500	-20C to +45C	Ex ia IIB T4 Ga
Energizer E91, EN91		
Duracell MN1500	-20C to +50C	Ex ia IIB T3 Ga

REPLACE BATTERIES WITH APPROVED TYPE IN NON-HAZARDOUS LOCATIONS ONLY

* Energizer is manufactured by Energizer Holdings, Inc., and the Eveready Battery Company, Inc.

Many other battery types and models have been tested but failed to meet the requirements for Intrinsic Safety - do not assume other models are equivalent. The nVision can be operated and powered from the mini-USB serial interface.

Warning: Do not use the mini-USB serial interface in a hazardous atmosphere.

Battery Life 200 hours (typical)

(1 reading per second recording, auto shutoff 20 minutes).

Settings such as Auto Shutoff, Logging Interval, and Backlight Shutoff greatly vary battery life.

The nVision screen display has the following power icon states:

Power Icon Key - nVision Reference Recorder						
Icon						
Description	External Power (USB)	100%	75%	50%	25%	0%**
		Power Remaining				
**Replace Batteries or connect to USB Power						



Power Icon Key - nVision Lab Reference		
Icon		
Description	External Power (AC Adapter)	USB Connection*
*USB Connection is for data transfer only		



Hazardous Locations



Note: The approvals do not apply to the nVision Lab Reference.

The nVision pressure gauge includes the following Intrinsic Safety approvals:

Exia IIB T4, SIRA 09ATEX2008X | This product conforms to the following standards:



- EN60079-0: 2006
- EN60079-11: 2007
- EN60079-26: 2007

IECEx SIR09.0053X | This product conforms to the following standards:



- IEC 60079-0: 2004
- IEC 60079-11: 2006
- EN60079-26: 2006

All module entity parameters may be found under the specific module specification section.

WARNINGS

The mini USB B connector shall not be used within the hazardous atmosphere. It shall be used in the non-hazardous atmosphere with either “Safety Extra Low Voltage Circuits” (SELV) or “Protective Extra Low Voltage Circuits” (PELV). The USB connector has an Um of 6V.

Substitution of components may impair intrinsic safety.

Replace batteries with approved type in non-hazardous locations only.

Parts of the enclosure may generate an ignition-capable level of electrostatic charge under certain extreme conditions. The user should ensure that the equipment is not installed or used in a location where it may be subjected to external conditions, which might cause a build-up of electrostatic charge on non-conducting surfaces. Additionally, cleaning of the equipment should be done only with a damp cloth.

Certifications

The nVision has been tested and certified to comply with a variety of international standards.

Crystal Engineering declares that the nVision is in accordance with the Electromagnetic Compatibility Directive and the Pressure Equipment Directive per our declaration(s).

ATEX EC Declarations of Conformity

Note: These approvals do not apply to the
nVision Lab Reference.



CRYSTAL
engineering corporation



EC Declaration of Conformity

Issued in accordance with the ATEX Directive 94/9/EC

Manufacturer: Crystal Engineering Corporation
708 Fiero Lane, Suite 9
San Luis Obispo, CA, 93401
USA

Products: nVision Reference Pressure Recorder
is in conformity with the provisions of the Directive 94/9/EC for use in potentially explosive atmospheres

Marking: II 1 G Ex ia IIB T4 Ga, Ta = -20C to 50C, Rayovac Max Plus 815
 II 1 G Ex ia IIB T4 Ga, Ta = -20C to 45C, Duracell MN1500
 II 1 G Ex ia IIB T3 Ga, Ta = -20C to 50C, Energizer E91, EN91
 II 1 G Ex ia IIB T3 Ga, Ta = -20C to 50C, Duracell MN1500

Harmonized Standards: EN 60079-0: 2006
EN 60079-11: 2007
EN 60079-26: 2007
IEC 60079-0: 2007 (Marking Guidance)

EC-Type Examination
Certificate: Sira 09ATEX2008X Issue: No. 1
Sira Certification Service, Notified Body 0518
Rake Lane, Eccleston, Chester, CH4 9JN
England

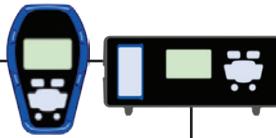
Production Quality Assurance
Notification: KEMA 04ATEXQ3155
KEMA Quality B.V., Notified Body 0344

EC Directives: 94/9/EC ATEX Directive
2004/108/EC EMC Directive

Name: David K. Porter, P.E.
Title: Director of Engineering
Date: 11 Feb 2010

PED EC Declarations of Conformity

Note: These approvals apply to the both the nVision Reference Recorder and the nVision Lab Reference.



EC Declaration of Conformity



I/We

Crystal Engineering Corporation

of

708 Fiero Lane, Suite 9
San Luis Obispo, CA, 93401
USA

declare that

nVision Series Reference Pressure Recorder	XP2i and XP2i-DD Series Digital Pressure Gauge
30 Series Digital Pressure Calibrator	M1 Series Digital Pressure Gauge

in accordance with the following directives

97/23/EC

Pressure Equipment Directive (PED)

have been designed and manufactured to the following

Pressure Gauges, Calibrators, and Recorders		CE Mark
Pressure gauges, calibrators, and recorders (pressure accessories per guideline 1/6)	The above listed pressure gauges, calibrators and reference recorders are designed and manufactured in accordance with applicable portions of Annex I, Essential Safety Requirements, and sound engineering practices. These pressure gauges or calibrators (classified as pressure accessories per guideline 1/6) have a volume (V) of less than 0.1 liter (Article 3, 1.1.(a) first indent, Group 1 fluids).	
Maximum Allowable Pressure (PS) < 200 bar (2 900 psig)	All pressure gauges, calibrators and reference recorders for use on gases or liquids below 200 bar (2 900 psig) are not subject to the essential requirements of the directive 97/23/EC (PED, Annex I) will be classed as Sound Engineering Practice (SEP), and shall not have the CE mark applied.	No
Maximum Allowable Pressure (PS) > 200 bar (2 900 psig), and < 1 000 bar (14 500 psig)	For pressure gauges, calibrators and reference recorders for use on gases or liquids above 200 bar (2 900 psig) on Class 1 & 2 gases or liquids, Crystal Engineering maintains a technical file in accordance with Annex III, Module A (internal production control) when CE mark is required.	Yes

I hereby declare that the equipment named above has been designed and manufactured to comply with all essential requirements of the Directives

David K. Porter, P.E.
(NAME OF AUTHORIZED PERSON)

Director of Engineering
(TITLE OF AUTHORIZED PERSON)


(SIGNATURE OF THE AUTHORIZED PERSON)

3 June 09
(DATE OF ISSUE)

EMC EC Declaration of Conformity

Note: These approvals do not apply to the
nVision Lab Reference.



EC Declaration of Conformity



I/We

Crystal Engineering Corporation

of

708 Fiero Lane, Suite 9
San Luis Obispo, CA, 93401
USA

declare that

nVision Series Reference Pressure Recorder

In accordance with the following directives

2004/108/EC

The Electromagnetic Compatibility Directive per:

CISPR 11:2003
EN 61326:2006

has been designed and manufactured to the following specifications

Pressure Modules (PM)

CISPR 11:2003	Radiated Emissions	Class B	Pass
EN 61326-1:2006 / EN 61000-4-2:2009	Electrostatic Discharge	Criteria A	Pass
EN 61326-1:2006 / EN 61000-4-3:2006	RF Radiated Immunity		Pass

Current & Voltage Module (MA20)

CISPR 11:2003	Radiated Emissions	Class B	Pass
EN 61326-1:2006 / EN 61000-4-2:2009	Electrostatic Discharge	Criteria A	Pass
EN 61326-1:2006 / EN 61000-4-3:2006	RF Radiated Immunity		Pass

Temperature Module (RTD100)

CISPR 11:2003	Radiated Emissions	Class B	Pass
EN 61326-1:2006 / EN 61000-4-2:2009	Electrostatic Discharge	Criteria B	Pass (1)
EN 61326-1:2006 / EN 61000-4-3:2006	RF Radiated Immunity		Pass

(1) Temperature changed value when ESD was applied to RTD100 module

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all essential requirements of the Directives

David K. Porter, P.E.
(NAME OF AUTHORIZED PERSON)

Director of Engineering
(TITLE OF AUTHORIZED PERSON)


(SIGNATURE OF THE AUTHORIZED PERSON)

12 February 2010
(DATE OF ISSUE)

EMC EC Declarations of Conformity

Note: These approvals do not apply to the
nVision Reference Recorder.



EC Declaration of Conformity



I/We

Crystal Engineering Corporation

of

708 Fiero Lane, Suite 9
San Luis Obispo, CA, 93401
USA

declare that

**nVision Laboratory Reference
NL-LAB**

In accordance with the following directives

2004/108/EC

The Electromagnetic Compatibility Directive per:
CISPR 11: 2003
EN 61326: 2006

has been designed and manufactured to the following specifications

CISPR 11: 2003	Conducted Emissions	Class A	Pass
CISPR 11: 2003	Radiated Emissions	Class A	Pass
EN 61000-3-2: 2005	Harmonics		Pass
EN 61000-3-3: 2006	Voltage Fluctuations & Flicker		Pass
EN 61000-4-2: 2001	Electrostatic Discharge		Pass
EN 61000-4-3: 2006	Radiated Immunity		Pass
EN 61000-4-4: 2004	Electrical Fast Transient / Burst		Pass
EN 61000-4-5: 2005	Surge Immunity		Pass
EN 61000-4-6: 2006	Conducted Immunity		Pass
EN 61000-4-8: 2001	Magnetic Field Immunity		Pass
EN 61000-4-11: 2004	Voltage Dips and Interrupts		Pass

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all essential requirements of the Directives

David K. Porter, P.E.
(NAME OF AUTHORIZED PERSON)

Director of Engineering
(TITLE OF AUTHORIZED PERSON)


(SIGNATURE OF THE AUTHORIZED PERSON)

2 July 2010
(DATE OF ISSUE)

Software

CrystalControl Configuration Software

Unleash the power of the nVision with CrystalControl. Customize your nVision chassis with the software's 'Config' capabilities in such areas as managing passwords, message stores, automatic shutoff and backlight timers, logging interval, disable and reorder viewing screens and more via the mini USB B interface. Also tailor your module's performance in such areas as disable unwanted units, create user defined unit (PM), change water density (PM), modify zero limits (PM), adjust calibration, change TCR and Callendar-Van Dusen coefficients used (RTD100), adjust base resistance (RTD100), and select lead type methodology (RTD100).

Accessories



Rack Mount Kit (for nVision Lab Reference only)

P/N 4302: Two rack mount ears with required hardware (Blank panel not included).

Replacement Parts



Soft Carrying Case (for nVision Reference Recorder only)

P/N 4087: Durable, padded case with separate pockets for your nVision and accessories

Protective Boot (for nVision Reference Recorder only)

P/N 3985: Skydrol™ resistant protective boot. Blue.

USB A to mini USB B Cable (included with all nVision chassis')

P/N 3951: 6' [1.8m] USB A to mini USB B Cable.

Warning: Do not use USB interface within a hazardous atmosphere (Um = 6V).

Test Lead Kit (included in MA20)

P/N 3952: Two 39" [1m] 2mm banana jack test leads with multi-purpose clip. Black / Red.

RTD Connection Kit (included in RTD100)

P/N 3953: One IP67 terminal block connector (RTD Module or RTD Sense Element not included).

ATEX and IECEx Scheme Safety Instructions



Note: These approvals do not apply to the nVision Lab Reference.

Bezpečnostní instrukce pro prostředí s nebezpečím výbuchu – ČESKY (Czech)

- V prostředí s nebezpečím výbuchu nepoužívejte přípojku USB.
- Baterie vyměňujte pouze v bezpečném prostředí. Používejte pouze schválené baterie.
- Za správné použití tohoto přístroje v prostředí s nebezpečím výbuchu odpovídá jeho uživatel.

Schválené baterie – ČESKY (Czech)

Přístroj nVision je jiskrově bezpečný pouze pokud je napájen jedním z následujících typů baterií:

Approved Battery Type	Ta=	Marking
Rayovac Max Plus 815	-20C to +50C	Ex ia IIB T4 Ga
Duracell MN1500	-20C to +45C	
Energizer E91, EN91	-20C to +50C	Ex ia IIB T3 Ga
Duracell MN1500		

REPLACE BATTERIES WITH APPROVED TYPE IN NON-HAZARDOUS LOCATIONS ONLY

Mnoho dalších druhů a typů baterií bylo zkoušeno, ale nesplnily požadavky na jiskrovou bezpečnost - nepředpokládejte, že jiné typy jsou rovnocenné.

Energizer vyrábí Energizer Holdings, Inc. a the Eveready Battery Company, Inc.

Sicherheitshinweise für explosionsgefährdeten Orten – DEUTSCH (German)

- Die USB Schnittstellenverbindung darf niemals in einer explosionsgefährdeten Umgebung benutzt werden.
- Der Batteriewechsel muß ausschließlich in sicherer Umgebung mit den vom Hersteller vorgeschriebenen Batterie-Typen erfolgen.
- Der Benutzer ist für den richtigen Umgang des Digitalmanometers in explosions- gefährdeter Umgebung verantwortlich.

Vom Hersteller vorgeschriebene Batterien – DEUTSCH (German)

Das nVision ist nur dann eigensicher, wenn die vom Hersteller vorgeschriebenen Batterien eingesetzt werden:

Approved Battery Type	Ta=	Marking
Rayovac Max Plus 815	-20C to +50C	Ex ia IIB T4 Ga
Duracell MN1500	-20C to +45C	
Energizer E91, EN91	-20C to +50C	Ex ia IIB T3 Ga
Duracell MN1500		

REPLACE BATTERIES WITH APPROVED TYPE IN NON-HAZARDOUS LOCATIONS ONLY

Es wurden viele andere Batterietypen vom Hersteller getestet, aber diese haben den Hersteller-Anforderungen für Eigensicherheit nicht entsprochen

Aus diesem Grund dürfen nur vom Hersteller vorgeschriebene Batterie-Typen in das Gerät eingesetzt werden, um die Eigensicherheit zu gewährleisten.

Energizer wird von Energizer Holdings, Inc., und der Eveready Battery Company, Inc. hergestellt.

Safety Instructions for Hazardous Locations – ENGLISH (English)

- Do not use the USB connector in a hazardous location.
- Replace batteries in non-hazardous locations, with approved batteries, only.
- It is the users responsibility to understand the proper application of this product in potentially explosive atmospheres.

Approved Batteries – ENGLISH (English)

The nVision is Intrinsically Safe only if powered by one of the following battery types:

Approved Battery Type	Ta=	Marking
Rayovac Max Plus 815	-20C to +50C	Ex ia IIB T4 Ga
Duracell MN1500	-20C to +45C	
Energizer E91, EN91	-20C to +50C	Ex ia IIB T3 Ga
Duracell MN1500		

REPLACE BATTERIES WITH APPROVED TYPE IN NON-HAZARDOUS LOCATIONS ONLY

Many other battery types and models have been tested but failed to meet the requirements for Intrinsic Safety - do not assume other models are equivalent.

Energizer is manufactured by Energizer Holdings, Inc., and the Eveready Battery Company, Inc.

Instrucciones de seguridad para zonas peligrosas – ESPAÑOL (Spanish)

- No use el conector USB en zona clasificada.
- Cambie las pilas en zona no clasificada, solo con pilas aprobadas.
- Es responsabilidad del usuario comprender la aplicación de este producto en atmósferas potencialmente explosivas

Pilas aprobadas – ESPAÑOL (Spanish)

El nVision solo es intrínsecamente seguro si se alimenta con uno de los siguientes tipos de pilas:

Approved Battery Type	Ta=	Marking
Rayovac Max Plus 815	-20C to +50C	Ex ia IIB T4 Ga
Duracell MN1500	-20C to +45C	
Energizer E91, EN91	-20C to +50C	Ex ia IIB T3 Ga
Duracell MN1500		

REPLACE BATTERIES WITH APPROVED TYPE IN NON-HAZARDOUS LOCATIONS ONLY

Se han probado muchos otros tipos de baterías pero han fallado el cumplimiento de los requisitos para la seguridad intrínseca - No asuma que otros modelos son equivalentes.

Energizer está fabricado por Energizer Holdings, Inc., y por Eveready Battery Company, Inc.

Instructions de sécurité pour les Zones Dangereuses – FRANÇAIS (French)

- Ne pas utiliser le connecteur USB dans une Zone Dangereuse.
- Remplacez les piles dans des Zones non-dangereuses, avec les piles appropriées, uniquement.
- Il est de la responsabilité de l'utilisateur de bien comprendre l'application appropriée de ce produit en atmosphères explosives.

Piles approuvées – FRANÇAIS (French)

Le nVision est un système à sécurité Intrinsèque seulement s'il est alimenté par un des Piles de type suivant:

Approved Battery Type	Ta=	Marking
Rayovac Max Plus 815	-20C to +50C	Ex ia IIB T4 Ga
Duracell MN1500	-20C to +45C	
Energizer E91, EN91	-20C to +50C	Ex ia IIB T3 Ga
Duracell MN1500		

REPLACE BATTERIES WITH APPROVED TYPE IN NON-HAZARDOUS LOCATIONS ONLY

Beaucoup d'autres types et modèles de Piles ont été examinés mais ne conviennent pas pour répondre aux conditions de sécurité intrinsèque - Ne jamais supposez que d'autres modèles pourraient être équivalents.

Les batteries Energizer sont fabriquées par les sociétés Energizer Holdings inc. et Eveready Battery Inc.

Prescrizioni di Sicurezza per Area Pericolosa – ITALIANO (Italian)

- Non utilizzare il connettore USB in Area Pericolosa.
- Sostituire le batterie in Aree non Pericolose e solamente con Batterie approvate.
- E' responsabilità dell'utilizzatore comprendere l'adatta applicazione di questo prodotto in atmosfere potenzialmente esplosive.

Batterie Approvate – ITALIANO (Italian)

L'nVision è a Sicurezza Intrinseca solo se alimentato da uno dei seguenti tipi di batteria:

Approved Battery Type	Ta=	Marking
Rayovac Max Plus 815	-20C to +50C	Ex ia IIB T4 Ga
Duracell MN1500	-20C to +45C	
Energizer E91, EN91	-20C to +50C	Ex ia IIB T3 Ga
Duracell MN1500		

REPLACE BATTERIES WITH APPROVED TYPE IN NON-HAZARDOUS LOCATIONS ONLY

Molti altri tipi e modelli di batteria sono stati testati ma non sono risultati conformi alle richieste per Sicurezza Intrinseca - non supponete che altri modelli siano equivalenti.

La batteria (Energizer) è fabbricata da Energizer Holdings Inc. e Eveready Battery Company Inc.

Veiligheidsinstructie voor gebruik in een explosie gevaarlijke omgeving – NEDERLANDS (Dutch)

- Het gebruik van de USB interface is niet toegestaan in een explosie gevaarlijke omgeving.
- Vervang de batterijen uitsluitend in een niet explosie gevaarlijke omgeving en gebruik alleen batterijen welke zijn goedgekeurd en toegestaan.
- De gebruiker dient er mee bekend te zijn welke gevaren er kunnen optreden in een explosie gevaarlijke ruimte bij gebruik van dit product

Het is de verantwoordelijkheid van de gebruiker om dit product op een juiste wijze toe te passen.

Batterijen welke zijn goedgekeurd – NEDERLANDS (Dutch)

De nVision is alleen intrinsiek veilig bij gebruik van de volgende batterijen:

Approved Battery Type	Ta=	Marking
Rayovac Max Plus 815	-20C to +50C	Ex ia IIB T4 Ga
Duracell MN1500	-20C to +45C	
Energizer E91, EN91		
Duracell MN1500	-20C to +50C	Ex ia IIB T3 Ga

REPLACE BATTERIES WITH APPROVED TYPE IN NON-HAZARDOUS LOCATIONS ONLY

Bij gebruik van andere niet gecertificeerde batterijen vervalt de intrinsiek veilige ATEX certificering.

Een aantal andere batterij merken en types zijn getest maar voldeden niet aan de ATEX voorwaarden voor intrinsieke veiligheid, U mag er daarom niet van uitgaan dat andere equivalenten types wel geschikt zullen zijn.

Energizer wordt gefabriceerd door Energizer Holdings, Inc en de Eveready Battery Company, Inc

Instrukcja Bezpieczeństwa Dla Srefy Zagrożonej Wybuchem – POLSKI (Polish)

- Połączenie USB może być używane tylko poza strefą zagrożenia wybuchem.
- Wymiana baterii tylko poza strefą zagrożenia wybuchem, używaż tylko zatwierdzony typ baterii.
- Odpowiedzialnością użytkownika jest używanie tego produktu we właściwy sposób w strefie zagrożonej wybuchem.

Zatwierdzone baterie – POLSKI (Polish)

nVision wersja Iskrbezpieczna może być tylko zasilana przez następujące typy baterii:

Approved Battery Type	Ta=	Marking
Rayovac Max Plus 815	-20C to +50C	Ex ia IIB T4 Ga
Duracell MN1500	-20C to +45C	
Energizer E91, EN91		
Duracell MN1500	-20C to +50C	Ex ia IIB T3 Ga

REPLACE BATTERIES WITH APPROVED TYPE IN NON-HAZARDOUS LOCATIONS ONLY

Wiele innych typów i modeli baterii przetestowano lecz nie spełniały wymagań Iskrbezpieczenia - nie przyjmuje się że inne modele są równoważne.

Energizer jest produkowany przez Energizer Holdings, Inc. lub przez Eveready Battery Company, Inc.

Räjähdyssvaarallisten tilojen turvallisuusohjeita – SUOMEN KIELI (Finnish)

- USB väylää/liitintä EI saa käyttää räjähdyssvaarallisissa tiloissa.
- USB väylää/liitintä EI saa käyttää räjähdyssvaarallisissa tiloissa. Käytettävä ehdottomasti ja ainoastaan hyväksyttyjä paristoja.
- Käyttäjän vastuulla on laitteen käyttö räjähdyssvaarallisissa tiloissa. Mittausovellus ja käyttöympäristö on ehdottomasti selvitettävä ennen käyttöä.

Käytöön hyväksyttyt paristot – SUOMEN KIELI (Finnish)

nVision mittari on turvallinen määritellyissä räjähdyssvaarallisissa tiloissa ainoastaan, kun käytetään seuraavia paristoja:

Approved Battery Type	Ta=	Marking
Rayovac Max Plus 815	-20C to +50C	Ex ia IIB T4 Ga
Duracell MN1500	-20C to +45C	
Energizer E91, EN91		
Duracell MN1500	-20C to +50C	Ex ia IIB T3 Ga

REPLACE BATTERIES WITH APPROVED TYPE IN NON-HAZARDOUS LOCATIONS ONLY

Monia muita paristotyyppejä on testattu, mutta on osoittautunut, etteivät ne täytä räjähdyssvaarallisten tilojen vaatimuksia.

Energizer tuotemerkiä valmistaa Energizer Holdings, Inc., ja Eveready Battery Company, Inc.

Troubleshooting

The nVision is a very high performance reference recorder. Due to the high resolution of this product, you may observe conditions that appear to be defects in the product, but are in fact a result of being able to read and measure pressure to a degree not possible with other instruments.

Noisy or unstable reading when used with fluids

When calibrating or comparing the indicated pressure from an nVision against a hydraulic deadweight tester or piston gauge, the reading on the nVision may appear unstable - the least significant digit jumps up and down several counts.

Reason: Gas (usually air) is trapped in the line between the nVision and the deadweight tester. What is actually happening is the mass is oscillating up and down, and the combination of gas and fluid is acting like a spring. At higher pressures (above 2000 PSI, typically) this may eventually diminish, as the gas dissolves into the fluid.

Solution: Evacuate all tubing with a vacuum pump, before introducing fluid into the system.

Non-repeatability of pressure measurements

When checking the gauge against a hydraulic deadweight, increasing pressure measurements do not match decreasing pressure measurements.

Reason: As in the previous note, gas has dissolved into the hydraulic fluid. When decreasing the pressure, the dissolved gas then leaves the fluid, but at an uneven rate, so small pressure differential (due to fluid head pressure) may exist between the reference deadweight and the gauge being tested.

Solution: Evacuate all tubing with a vacuum pump, before introducing fluid into the system.

Slow return to zero and/or non-repeatability of pressure measurements

Reason: Pressure port is obstructed.

Solution: Clean with low pressure fluid. Do not touch diaphragm as damage will result

Error 1 displayed

Reason: The nVision checks the integrity of internal calibration coefficients every time it's turned on. If any coefficients have been corrupted in any way, "Error 1" is displayed.

Solution: Contact factory for instructions on how to restore the memory to the original factory settings.

Error 2 displayed

Reason: The nVision has tried to display a number too large for the display (i.e., more than 6 digits). May be due to an electrical malfunction or numerical error.

Solution: Contact factory for further instructions.

Error 5 or Error 6 displayed

Reason: The nVision pressure module (PM) is exhibiting out of normal operating condition behavior.

Solution: Contact factory for module replacement.

Error 7 displayed

Reason: The nVision has lost communication with one or both of your modules.

Solution: It may be possible to recover from this condition by removing and reconnecting your modules using the Module Installation Instructions in this manual. This may happen if you change modules but do not remove and replace the 4AA or AC Power to the unit to force a complete reset of the product. Once this is done the module should be recognized properly. If unsuccessful in resolving the issue, contact factory for module replacement.

Date and Time are incorrect

Reason: The nVision has its date and time synchronised to computers located in our factory.

Solution: Connect to CrystalControl on a computer with the correct date and time settings you desire. During the connection process, the nVision will be synchronized to the local time.

Trademarks

This manual contains the following third-party trademarks, both registered and unregistered. All marks are the property of their respective companies.

Rayovac® and Maximum Plus™ Rayovac Corporation

Duracell® Duracell Inc. Corporation

Energizer® and Eveready Eveready Battery Company, Inc.

“Pressure is Our Business” is a registered trademark of Crystal Engineering Corp.

Service and Support

How to Contact Us:

Phone (805) 595-5477

Toll-Free (800) 444-1850

Fax (805) 595-5466

Email service@crystalengineering.net

Web www.crystalengineering.net

If calling, have ready the model number, serial number, date of purchase and reason for return. You will receive instructions for returning the device to Crystal Engineering.

Send your comments to: sales@crystalengineering.net

Warranty

Crystal Engineering Corporation warrants the nVision Reference Pressure Recorder to be free from defects in material and workmanship under normal use and service for one (1) year from date of purchase to the original purchaser. It does not apply to batteries or when the product has been misused, altered or damaged by accident or abnormal conditions of operation.

Crystal Engineering will, at our option, repair or replace the defective device free of charge and the device will be returned, transportation prepaid. However, if we determine the failure was caused by misuse, alteration, accident or abnormal condition of operation, you will be billed for the repair.

CRYSTAL ENGINEERING CORPORATION MAKES NO WARRANTY OTHER THAN THE LIMITED WARRANTY STATED ABOVE. ALL WARRANTIES, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, ARE LIMITED TO A PERIOD OF ONE (1) YEAR FROM THE DATE OF PURCHASE. CRYSTAL ENGINEERING SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT OR OTHERWISE.

Note (USA only): Some states do not allow limitations of implied warranties or the exclusion of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may have other rights which vary from state to state.

CRYSTAL

engineering corporation

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